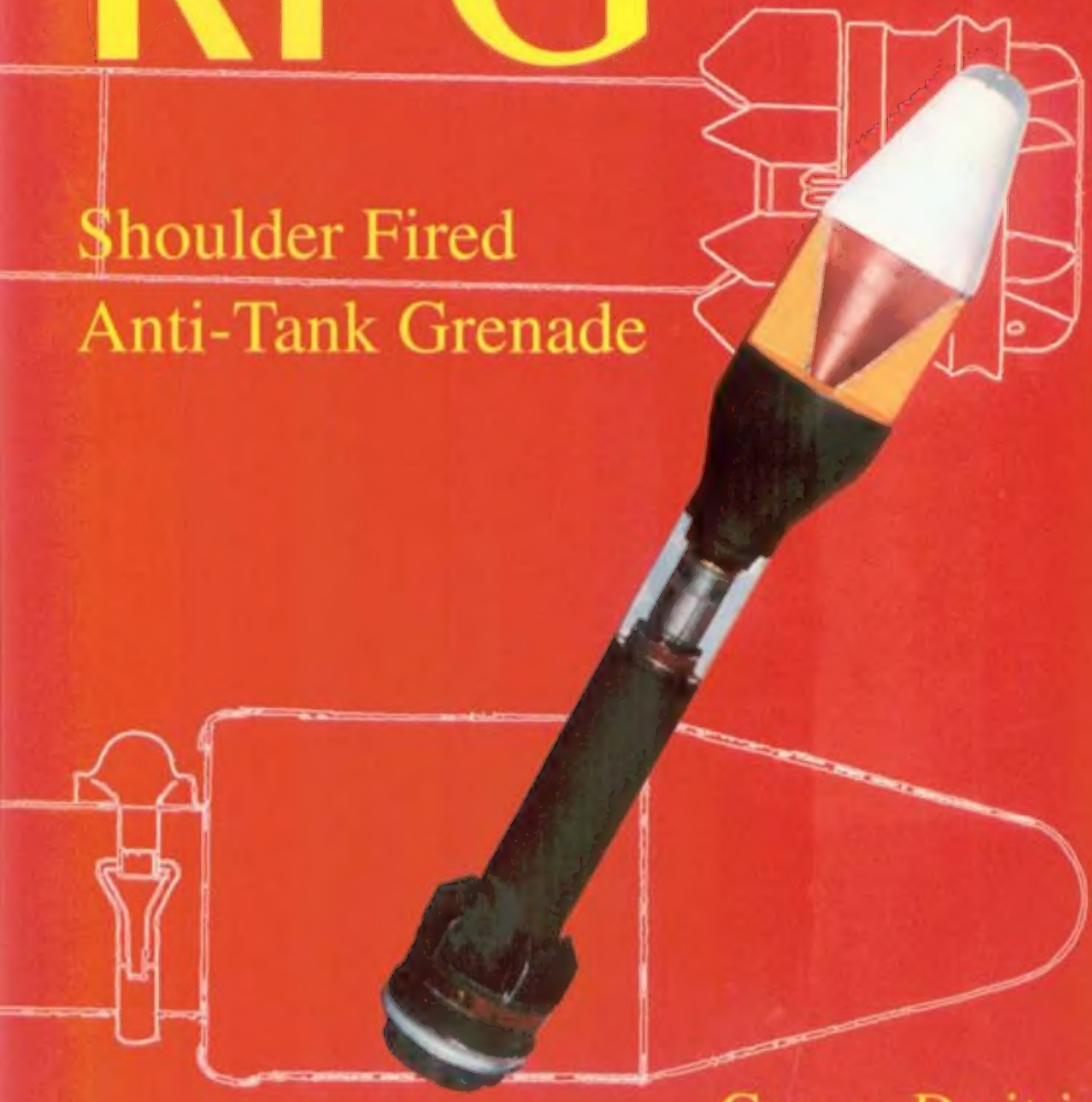
The Poor Man's RPG

Shoulder Fired Anti-Tank Grenade



George Dmitrieff

The Poor Man's RPG

Shoulder Fired Anti-Tank Weapon

by

George Dmitrieff

© 1996 by George Dmitrieff

Published by Desert Publications
P.O. Box 1751
El Dorado, AR 71731-1751
501-862-2077

ISBN 0-87947-154-9
10 9 8 7 6 5 4 3 2 1
Printed in U. S. A.

Desert Publication is a division of
The DELTA GROUP, Ltd.
Direct all inquiries & orders to the above address.

All rights reserved. Except for use in a review, no portion of this book may be reproduced by any means known or unknown without the express written permission of the publisher.

Neither the author nor the publisher assumes any responsibility for the use or misuse of the information contained in this book.

Warning

The information provided in this monograph is not intended for the manufacture or use of the described antitank weapons.

Such weapons and devices are subject to various Federal, State, and local regulations. Furthermore, the construction of rockets and warheads entails handling of dangerous explosives and propellants which can cause serious injury or even death.

The Author and publisher do not condone nor take any responsibility for misuse of the information in the present text.

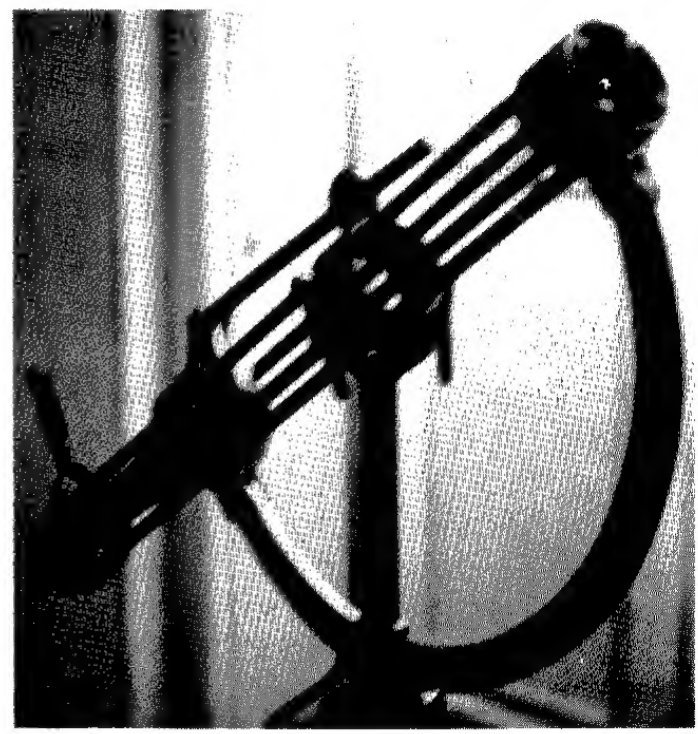
Table of Contents

Chapter I

Historical Notes

Looking through the pages of military technology one common thread becomes apparent. It was the small, relatively simple inventions which had a profound effect on new tactics.

It was the simple stirrup which converted an armed rider on horseback into a formidable mounted war machine. The attachment of a spear point to the muzzle of a firearm changed the musketeer into an infantryman with impressive attack capabilities. The machine gun, in turn, forced the infantryman to use a shovel almost as much as the rifle, and practically eliminated the cavalry from the battlefield.



A "Bazooka" used by Austro-Hungarian Army in the 1860's

And lastly, the shoulder-fired rocket with a shaped-charge warhead made the tank (and the helicopter) quite vulnerable to fire by individual fighting men. If the rocket-launched antitank warhead, as recommended by military technologists in the 1930's, had been accepted by the various General Staffs, the concept of the Blitzkrieg would have been unthinkable.

While rockets were used since the twelfth century and the recoilless rifles were tested by the end of World War I, these weapon types were not equal in performance to the conventional artillery of the day. Furthermore, there was no need for antitank weapons when the tank did not exist.

The hand grenade has been called a one man's mortar. The shoulder fired HEAT (High Explosive Anti-Tank) warhead may be called a one man's artillery.

It is effective not only against armored vehicles, but has been used against bunkers, and as an antipersonnel projectile against troops in the open field.

In the Vietnam war the RPGs were even used against low-flying helicopters with success. This last application is not new in concept either. Towards the end of World War II the German Command was developing a "Fliegerfaust" intended to shoot down aircraft engaged in dive-bombing and strafing the ground troops. The famous "Stinger" is the most successful of this type application. Some information on these weapons is included in the appendix.

The first successful shoulder-fired HEAT warhead was the United States model M-9 rocket launcher firing the 2.36 inch (60 mm) M-6 series rocket. This weapon, introduced in 1942 in the North African theater of operations, was an immediate success. The weapon's basic elements of a fin-stabilized warhead with a shaped charge and standoff shield, propelled by recoilless means, have been copied and/or improved ever since. The Panzerfausts, RPGs, M-72A2 (LAW), Viper, Armbrust, Milan, etc., all incorporate some or most of the elements of the venerable Bazooka.

Now, let's review the principal requirements of a shoulder-fired antitank weapon. These are:

1 - LETHALITY - i.e. the HEAT warhead has to stop and/or disable a tank even with a hit of the front glacis (the sloped front and most heavily armored part of the tank).

The World War II missiles were generally adequate for this purpose. It must be appreciated that any change in the warhead weight has 3-4 times that effect on the total projectile weight. An increase in warhead size will require a larger and/or heavier motor, more propellant and possibly a longer launcher just to keep the exterior ballistics the same as before. It is therefore most important to keep the warhead as small as possible and light, without loss of terminal effect. Such a light warhead in turn allows for reduction in the motor and propellant elements.

2 - HIT PROBABILITY - the ability to hit a target depends firstly on the projectile characteristics, such as in-flight velocity, (thus the time of flight from the launcher to the target) and the inherent accuracy (reduced dispersion due to better aerodynamic shape, propulsion method, fin design, etc.).

The second factor of hit probability is the type of sights used. An expendable, one-shot weapon usually uses the simplest kind of open sights. In turn a reloadable launcher is generally provided with good quality optical sights. Furthermore, such optical sights are normally sighted in with the launcher, producing a more accurate weapon. This was the principal advantage of the Bazooka over the Panzerfaust.

3 - RANGE- a longer range for a weapon is always desirable because it allows the shooter to engage the target earlier and also gives him a better survival chance against detection and retaliation fire.

The actual field use, however showed that the maximum effective range of the World War II weapons was only about 100 meters. Even today's improved models are considered practical to ranges of 250-300 meters. The tank size, moving target and the hit probability of the projectile are the limiting factors.

4 - PORTABILITY - the advantages of light weight and compact size are obvious. Unfortunately a compromise and trade-off are necessary in actual field product. The factors affecting the final decisions (aside from subjective opinions) are the tactical applications, anticipated major combat environment (deserts, woods, towns, etc.), resources available, and urgency of the end-user in getting the weapon. Again the Bazooka and the Panzerfaust are classic examples of the final decisions of such factor evaluation.

5 - COST - the cost of a system is representative of the labor and materials needed to produce a weapon without sacrificing on the above-mentioned performance parameters. This cost does not appear important when considering a few hundred or even thousand units. However, when such items are produced in hundreds of thousands and under emergency situations, the cost and the resulting drain on materials and production facilities can become critical.

The Bazooka and the Panzerfaust are classic examples of final decisions based on evaluation of the above factors.

While these weapons started with the Bazooka, a crew-served, non-expendable, bulky launcher, with long range and good accuracy, the other combatants made other decisions.

The British "PIAT" with the manual cocking of the launching spring was not only a sad concept, but did not compare with the systems described in this text. The Red Army in the beginning of the war did not have the time and resources for rocket propelled HEAT weapons. From 1943 they did not see the need for it. The Germans in turn did not see the need for individual antitank HEAT weapons till the 34's started rolling over their lines.

When the war was over and the various weapon evaluations started, the effectiveness of the Bazooka and Panzerfaust began to be fully appreciated. A new era of design and development began.

The key improvements of the later systems were:

- Piezoelectric fuze (i.e. instant acting)
- Better aerodynamic form of the projectile
- More powerful high explosive charge
- More reliable detonator
- Higher efficiency rocket motor

- Higher performance rocket propellant
- Addition of a primary launching cartridge
- Improved in-flight stabilization due to better fin design
- Use of optical sights
- Use of optional tracking guidance
- Use of reinforced plastic instead of metal, making components less expensive and lighter
- Improved production and assembly methods

At present the development of more powerful, lighter, more accurate, and longer range expendable shoulder-fired HEAT-warhead armed weapons continues in many countries. Such development is not the subject of this monograph.

In the present text the 3.5-inch HEAT, M28A2 rocket has been selected as a sample for the various re-enactment models. It is relatively simple in construction, reasonably reliable, and quite adequate for the purpose intended. The drawings and sketches of the individual components give sufficient information on the materials and methods of assembly of the rocket.

These methods were reflecting the knowledge and technology of the time. As manufacturing methods and experience grew, so did the design of new type rockets. The M72 rocket is therefore included for comparison. The most obvious changes are the new rocket motor made from aluminum alloy instead of steel and the tail assembly of thin blade individual fins. The ignition system has been changed from electric to percussion primer, like the old Panzerfaust, or the RPG. This allows for better storage life, simpler manufacture and a more reliable ignition.

And finally, the performance parameters, such as muzzle velocity, range and penetration have also changed. These parameters change quite often and are more influenced by the purchaser's subjective opinions than rationale. This is nothing new. It is similar to the continuous discussion of .45 caliber versus 9MM, the 5.56MM vs 7.62MM, the high cyclic rate multi-barrel 20MM vs 30MM or 57MM, the 100MM rifled tank gun vs the 120MM smooth bore, etc., etc. ad absurdum.

Section II

Propulsion Basics

The principle of rocket propulsion is based on the law of physics "every action produces an equal and opposite reaction." This, in simple terms is demonstrated in an example of a man sitting on a raft in the middle of a quiet pond. By jumping from the raft into the water the man pushes the raft in an opposite direction. The speed of the raft multiplied by the raft mass will equal the speed of the man multiplied by his mass. Similarly, the rocket warhead, or the recoilless rifle shell are the raft, while the gases (and other materials) "jumping away" "kick" the rocket-projectile towards the target. The projectile "pushing" system may be of three basic types.

A - a pure rocket in which the acceleration of the projectile is performed only by the reaction of the propellant combustion gases. Such performance is enhanced by a suitable combustion chamber and nozzle configuration. Some data on simple rocket propellants and rocket geometry are given in the Appendix. The Bazooka uses a pure rocket propelling system.

B - a pure "momentum" system in which the projectile mass (or weight) is accurately balanced by the mass (weight) of the gases and the metallic or plastic particles. Both are expelled from the tube with the same force and velocity so that the shooter does not feel any appreciable recoil of the launcher. The Panzerfaust was built on this principle.

C - a combination of the "momentum" and rocket. The two stage propulsion method, which launches the projectile like the Panzerfaust type recoilless charge and then several meters out of the launcher lights up the rocket motor. This approach is more complex mechanically than the single stage propulsion system but has the following merits:

- Lower launcher signature, i.e. less muzzle blast and smaller mass expelled to the rear.

- Reduced launch velocity.
- Shorter launcher.
- More adaptable for use in restricted space.
- The expelling unit acts essentially as the first stage of a rocket system improving the efficiency of the actual rocket motor.
- Allows for a more flexible design of the complete weapon system.
- Allows lighter motor construction since the rocket propellant may burn more slowly while accelerating the projectile down the range.
- Safety, in case of defects in construction and/or handling of the launcher, motor and the propellant charge, the shooter is not subject to the same high pressures and forces as in the single stage system. This is particularly important when considering the closeness of the shooter's head to the launcher during firing.

The penalty in using the two stage system is the inherently poorer accuracy, particularly in cross wind. While a one stage launched warhead is subject to the drift only, the projectile-with rocket motor which continues to burn during flight tends to turn head-on into the wind. The RPG7 is based on such a hybrid system.

So far everything is simple and straightforward. The real problem is in the practical configuration of such a launching method. The weapon must be as short and light as possible. Yet it must be powerful enough to penetrate and disable any existing (WW II) armored vehicle. It also has to have a reasonable range, flat trajectory and good accuracy to hit the target (approximately 3m wide by 2m high) moving at about 7 meters per second.

To hit and penetrate such armored targets requires a powerful projectile. In the past such a projectile was a high velocity kinetic penetrator. This was a hardened steel or tungsten sub-caliber projectile fired from an artillery weapon (gun or howitzer) of large caliber (75 - 150 mm). Obviously, a shoulder-fired launcher required a different type of projectile. The solution was a shaped charge warhead.

The basic characteristics of such warheads are discussed in detail in the next chapter. Although the launcher was reasonably short and light, the warhead had to be accelerated to its maximum velocity within the launcher length. This in turn required a development of a special propellant which would burn at relatively low pressure and produce a maximum gas volume within the time before the warhead exited from the front end of the launcher. Details of the material and design features of the propulsion components are described further in the text.

An interesting characteristic feature of the antitank shoulder launcher is the absence of recoil.

The propellant gases leaving through the launcher end nozzle (in the RPG-7 types) produce a reactive force forward, thus balancing the recoil forces. The force of gases on the front portion of the launcher chamber produce a barely noticeable launcher motion forward.

The performance specifications selected by the using service determine not only the final choice of the warhead and propulsion components, but also the type and form of the launcher. The U. S. Service apparently opted for longer range and a reusable weapon resulting in a 150 cm long Bazooka tube. The German Command selected a shorter range expendable unit, while the Soviet designers (after WW II) having the opportunity to study both systems, chose to use the best features of both.

To appreciate the performance of the World War II shoulder-fired rocket launchers consider that the HEAT warhead velocity, through its effective range, was about the same as the velocity of a .22 rimfire bullet, i.e. about 300 rn/sec. The weight of the high explosive charge in the warhead was comparable to that of 3-5 offensive type hand grenades. No wonder these devices are so popular with the irregular forces around the world even today.

The shapes and construction of these three basic launchers are shown in the respective chapters.

The energetic materials employed in the shoulder-fired antitank weapons may be separated into two groups:

A - Propellants, i.e. materials needed to launch the projectile to the target.

B - High Explosives, used in the shaped charge warhead.

Each of the above groups requires ancillary pyrotechnic and/or explosive materials such as igniters, delays, boosters, fuses, etc.

The propellants are almost invariably high energy, double base (Nitrocellulose with Nitroglycerine) powders adjusted for uniform burning at relatively low pressure (±500 Atmospheres = 7500 psi). The burning rate is designed so that the propellant grain is fully consumed within the time needed for the projectile to exit from the launcher. The burning rate is controlled by the appropriate chemical composition of the powder and the actual geometry of the powder grains. The control of the burning rate is more critical than that of normal artillery powders because the infantryman is exposed to any unburned or late burning propellant while the gunner is not.

For playacting and reenactment demonstration only the following may be applicable.

The most common solid propellant rocket fuel used by amateur rocketeers are:

Zinc dust powder	2/3 (by weight)
Sulfur powder	1/3 (by weight)

The components are placed into a non-sparking (wooden) container and blended by rotation and/or shaking of such container until a powder of uniform color is produced. For small quantities of propellant the most convenient method is to place the components onto a sufficiently large sheet of paper or dense cloth. By alternate lifting and lowering of the sheet sides, the material is uniformly blended. The blended propellant is carefully ladled into the rocket body with a non-sparking spoon. After the addition of a small portion of the powdered propellant, the rocket body is vibrated by tapping with a wooden or rubber mallet, or an electric vibrator (hand held electric sander) To prevent an open spark, the vibrator is enclosed in a heavy plastic bag.

The propellant will produce chamber pressures of about 70 Atmospheres (1000 psi). Addition of a small amount of ethanol to the blended powder produces a paste-like mix which can be stuffed into the rocket motor. It should be cured at ambient temperature for 5 to 7 days. The resulting rocket grain is a hard smooth material which can be sawed or machined. The grain requires more burning surface than the end burning type and therefore is usually formed in tubular form. This propellant will produce respectable results in a reenactment weapon, but the charge must be small to finish burning before the warhead exits.

The second, most common amateur rocket propellant is a mixture of:

Potassium nitrate	60 % (by weight)
Sugar	40% (by weight)

These components are blended in the same manner as the Zinc–Sulfur mix. The blended material is then slowly and carefully heated in a double boiler with glycerine (instead of water) to a temperature of 175° - 200°C (350 - 400° F). The molten mass is carefully poured directly into the rocket motor. To prevent air bubbles and stress cracks at cooling, all pouring ladles, funnels, and the motor body must be preheated to the melting temperature of 175°C. The propellant must be poured into the body in one step only. Any interruption in the pouring process will affect the grain cooling and cause cracks, resulting in erratic burning and possible explosion. This method of propellant preparation is used only by experienced individuals with proper equipment and under carefully controlled conditions.

The third basic rocket propellant is the venerable black powder which is available from sporting gun stores. However, the powder used in the traditional muzzle loading arms is more powerful than that used in the rockets. To make a rocket powder from the hunting powder approximately 40 grams of fuel (charcoal or sugar) are added to every 100 grams of the hunting black powder. The charcoal may be made from barbecue brickettes broken down and screened for size.

A one pound size coffee can with a piece of wood and a kitchen sieve are all the basic tools you'll need. The same can with a plastic cover also serves as a "blending drum" for the components, i.e. black powder and charcoal/sugar. This propellant blend will practically duplicate the traditional pyrotechnic rocket composition of:

Potassium nitrate - oxidizer	55 % (by weight)
Sulfur - fuel enhancer	10 %
Charcoal - fuel	45 %

More powerful rocket black powder propellants use a higher percentage of oxidizer, while reduced power propellants use less oxidizer.

The rocket propellant powder (blended) is poured into the rocket motor body in small portions and compacted as described in the respective section.

Many other types of reenactment expedient rocket propellants have been tried in the past. Smokeless rifle powders were blended with acetone, paraffin and other materials. The resulting propellant grains were sometimes difficult to ignite, some produced erratic burning rates while others generated excessively high pressures. None was as convenient as the propellants described previously.

The final source of propellant (and rocket motor) are the various rockets available from the hobby stores. These are generally the safest to use and are the best choice if the whole rocket and warhead (dummy) are of cardboard construction.

The rocket motor burning time and the appropriate length of the launcher can be determined by the following simple method.

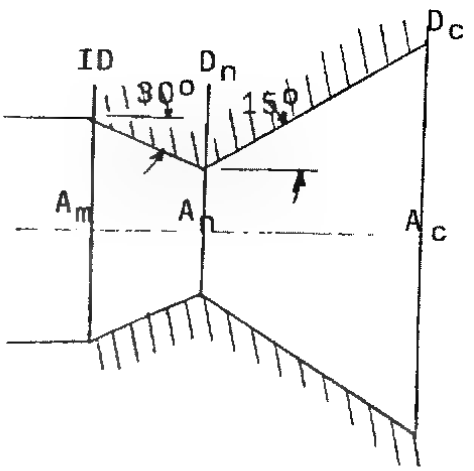
Take a launcher with a tube about one meter longer than the estimated final length. Starting about three quarters of a meter from the rear end, drill in the launcher tube a series of holes (about 3/16 inch in diameter) approximately ten centimeters apart, toward the muzzle. Cover each hole with a piece of tape (ordinary Scotch tape or masking tape). When the rocket (with dummy warhead) is fired, the tape without burn marks shows the location where the propellant burned out.

In the reenactment rocket motor the igniter (see schematic diagram) is placed at the NOZZLE END of the motor. This is essential because the propellant in this case is only one solid grain of Zn-S composition.

To make motors (and hence the whole projectile) lighter, yet strong enough, the latest rocket motor bodies are manufactured from wound fiberglass filament. This very same method was used years ago to make the Winchester model 59 shotgun barrels. A paper-thin steel liner was reinforced by multiple windings of fiberglass filament. The barrel was then coated with epoxy and painted black.

REENACTMENT ROCKET NOZZLE DESIGN

FUEL: Zinc-Sulfur mix (2:1 by weight)
flame temperature ±1450°C
burning rate 230 cm/sec



Recommended relationships of nozzle

Area of Motor = 3 Area of Nozzle
Area of Cone = $7^1/_2$ Area of Nozzle

TABULATED VALUES FOR REENACTMENT ROCKET MOTOR DIMENSIONS

MOTOR BODY NOMINAL SIZE PIPE Sch.40	MOTOR ID MM	ID^2	$^1/_3\ ID^2$ $=D_N^2$	D_N	$7^1/_2 D_N^2$	D_C
1"	24.4	642	214	14.6	1810	42.5
$1\ ^1/_2$"	41	1680	560	23.6	4200	64.7
M28A2	42			22		60

Note: the above reenactment motor values agree quite well with the actual Bazooka rocket motor dimensions, particularly when considering the differences in the fuels.

BURSTING PRESSURES FOR BUTTWELD STEEL PIPE

AS USED FOR THE REENACTMENT ROCKET MOTORS

PIPE NOMINAL SIZE inches	PIPE OUTSIDE DIA. millimeters	SCHEDULE 40 (STANDARD WEIGHT) PIPE INSIDE DIA. millimeters	BURSTING PRESSURE PSI
1"	33.2	26.7	9100
$1^1/_4$"	42.2	36.1	7600
$1^1/_2$"	48.2	41	6850

Note: For comparison, the 12-ga. shotgun barrel has an inside diameter of 18.5 mm and the maximum mean (not proof) pressure of a shotshell is 11,600 PSI (slug load).

The ignition systems of the propellant cartridges in the shoulder fired launchers are of two types:

a - mechanical

b - electrical

The mechanical ignition unit used in the Panzerfaust and the RPG may be compared to the conventional small arms unit. A pull on the trigger releases the hammer which hits the firing pin. The firing pin in turn strikes the small percussion primer, igniting the booster and the propellant itself. This system is simple, safe and reliable. Furthermore it may be inspected visually for defects.

The electrical ignition system consists of an electrical energy source, magneto , or battery, suitable wires and an electrical squib (a hot coil) imbedded in readily ignited booster. Pulling the trigger closes the circuit and sends an electric impulse through the wires to the squib. The thin wire of the squib is heated red, igniting the booster and the propellant. This system is also simple and reliable, but requires protection from external electromagnetic impulses by careful grounding. Inspection of the electrical circuit does require the use of an Ohm/Volt meter.

The Panzerfaust igniter is of the mechanical type. However, due to the type (recoilless) and the geometry of the launcher, such a mechanical igniter requires relatively large amounts of machining to make it positive and safe.

For reenactment purposes it is simpler and safer to use an electric igniter. Such an igniter may be attached to the propellant cartridge and seated into the launcher tube from the rear, prior to insertion of the expelling counterweight of sand and/or iron filings. This method assures that there are no openings in the launcher tube.

In summary, the advantages of a reenactment electrical igniter are:

- It does not require the equipment and tools needed to build a mechanical unit.

- The magneto assembly may be replaced by a battery.

- All components for the electrical circuit are readily available, off-the-shelf items (switches, wires, batteries , igniter/hot coil, booster powder).

- The construction of an electric unit is simple and the tooling needed consists of a pair of small pliers and a small soldering iron.

Reenactment Rocket Ignitor, Electric

REENACTMENT ROCKET MOTOR ELECTRIC IGNITER

EQUIPMENT:

1 - Small hand drill with assorted drill bits

2 - Single edge razor blade

3 - Small file

4 - Small soldering iron

5 - Scissors

MATERIALS:

1 - Flashlight bulb (PR2 or equivalent)

2 - Black powder, FFFG

3 - Adhesive tape, Scotch tape type

4 - Adhesive cement for plastic models or equivalent

5 - Stopper, cork or rubber (to fit the motor nozzle diameter)

6 - Insulated wire; electronic equipment type

7 - Flashlight batteries, 2 each, D-cell

8 - Soft solder wire

PROCEDURE:

1 - Clean off approximately 4mm (3/16") insulation from two wires.

2 - Solder one wire (A) to the side of the flashlight bulb.

3 - Solder another wire (B) to the insulated knob at the bottom of the bulb.

Note: Be sure that the soldered ends of the wires do not contact each other, and are marked A-ground, B-hot.

4 - Drill a hole through the center line of the stopper large enough for both wires to pass through.

5 - Counter bore the small end of the tapered stopper so that the bulb body fits in snugly and seats to the rim.

6 - Pull the wires through the stopper hole.

7 - Apply a small bead of adhesive around the counter bore hole edge.

8 - Gently seat the bulb in place.

Note: Be sure that the soldered joints are not damaged.

9 - For safety apply adhesive at the exit end (large diameter of stopper) so that any accidental pull on the wires does not damage the soldered contacts.

10- After the adhesive dries, take the stopper with the bulb and with GENTLE and SLOW strokes file off the top of the glass bulb until a hole of approximately 3mm ($^1/_8$") diameter is formed.

11- Form a small funnel from a small paper strip; SLOWLY pour the black powder into the bulb so that it does not break the thin wire coil inside. Fill the bulb completely.

12 - While keeping the bulb in an upright position (to prevent spilling the black powder) close the bulb opening with a small piece of adhesive tape or a drop of glue.

13 - Connect the two wire ends to the battery; wire (A) to the "ground" or "-" end, the wire (B) "hot" is temporary shunted (connected) to the ground wire with a clip or other means.
The igniter is now ready for insertion into the rocket motor nozzle.

Notes:

1 - If a fine lead wire is not available, a piece of light duty electric extension cord (as used for small appliances) is usable.

2 - two (2) D-cell batteries (fresh) will actuate a PR2 bulb over 4 $^1/_2$ meters (15 feet) of light duty electric extension cord.

3- After step 8 check the electric conduction by two (2) D cell batteries; the bulb should light up if all joints are good. DO NOT test the connections after the bulb is filed open; it would burn the bulb filament and make the igniter inoperative.

The RPG2 is basically a copy of the Panzerfaust, hence the reenactment model may use the same electric igniter as the reenactment Panzerfaust. The RPG7 uses a mechanical igniter for the expelling charge and a delay which in turn ignites the rocket motor at a safe distance from the muzzle. Again, like in the reenactment Panzerfaust it is simpler and safer to use an electric igniter for the expelling charge and a delay igniter for the rocket motor.

Chapter III

Shaped Charge Warhead Basics

The shaped charge warhead of an antitank projectile is based on the technique of directional control of the energy generated during a high explosive detonation. Instead of allowing the gases to expand in a radial direction, they are focused into a narrow jet. This may be compared to a light being focused by a conical reflector into a sharp beam.

In a shaped charge warhead the fuze fires a primer which initiates the detonator which in turn sets off the main charge. The detonation wave of the formed charge reaches the apex of the liner producing very high pressure, causing the liner wall to collapse. The inner portion of the liner cone forms a molten jet travelling at a high speed along the charge axis. The velocity of this gas-metal jet approaches the burning rate of the high explosive used (i.e. 5000-8000 m/sec). Such a jet may penetrate armor to a depth twice that of the liner diameter. The jet-metal performance inside the target is further accentuated by the fragments of the armor from the penetration hole.

For the best performance the liner is brazed to the warhead body around its entire circumference. The joint is then carefully inspected and tested under hydrostatic pressure and very rigid controls. After the liner-warhead assembly passes the inspection, the standoff shield and the conductive hood (if the piezo fuze is in the projectile nose) is crimped and/or brazed to the warhead. After a final waterproofing with a silicone-like adhesive the warhead is ready for filling with the explosive charge.

The explosives used in the warhead are high energy materials. The final choice is dictated by the availability of such an explosive, the method of filling and forming the charge and the urgency to transfer the weapon into the end user's hands.

The 2.36 inch warhead (HEAT - M6) held approximately 450 grams of Pentolite, a mixture of PETN and TNT in 50/50 proportion. The 3.5 inch warhead (HEAT - M28A2) contained 850 grams of Composition B. The Panzerfaust 150 warhead was charged with approximately 900 grams of mixture of RDX and TNT in 50/50 proportion. Both, the PETN (Pentaerythritol tetranitrate) and RDX (Trimethylentrinitraamin) are excellent high explosives - powerful, relatively safe


2.36INCH HEAT M6A5
ROCKET
WARHEAD


3.5 INCH HEAT M28A2
ROCKET
WARHEAD

in handling and storage, stable, and produced from readily available raw materials. Their one main drawback is in their physical form. They are fine powders and are not castable.

During filling and loading operations the PETN and RDX are usually blended with a small percentage of a binder, then compacted into small pellets to prevent dusting. Only then are these explosives deposited into the projectile (or mine) and compressed in a hydraulic press. Shaped charge warheads with thin and light walls are not readily suited for such compression of explosive filler. Thus PETN and RDX are added in loose powder form to molten TNT and blended into a thin porridge-like slurry. Such liquid is then poured into the warhead body and solidified by cooling.

This operation is a very closely controlled one. The metal parts of the warhead are first preheated to about five degrees Centigrade higher than the temperature of the poured explosive.

While the explosive is being poured, the warheads are vibrated to such a degree that a slight movement of the molten filler may be observed. The amount of the poured explosive exceeds slightly the required quantity for each charge. This, like in casting metals, eliminates the voids during shrinkage at cooling and assures a full and uniform warhead charge.

The overall performance of a shaped charge warhead depends on the following factors:

1 - Type of high explosive used in the main charge - the more powerful the better.

2 -Standoff distance - the distance between the base of the liner and the target surface. The target penetration increases with the increase of the standoff distance until the standoff equals about 3 times the liner diameter. Any further increase in standoff will decrease the penetration.

3 - Liner diameter - an armor penetration is about 1 $^{1}/_{2}$ times the liner diameter.

4 - Liner cavity form - a hollow cone of 42° produces optimum performance. Other forms tried were ellipsoidal, paraboloid, etc.

5 - Liner material: of all materials tried, the best was copper, then steel; aluminum was not very effective.

6 - Liner walls : tapering of the liner thickness improved the performance.

7 - Projectile rotation: high speed rotation (such as artillery shells) markedly decreases the shaped charge effect.

If the shaped charge and the target were stationary (like a cratering charge) the selection of the best condition would be relatively simple. However, the target and the projectile are mostly moving during the impact. The standoff distance then becomes a variable, depending on the impact angle of the warhead and the strength of the standoff shield. Furthermore, the projectile continues moving towards the target after the impact and before the detonator sets off the charge. In the early models of the Bazooka, Panzerfaust and the PG-2, the detonator was fired mechanically by impact of a striker against a percussion primer. This induced a long delay.

Present day warheads use mostly piezo-electric fuzes and electric bridge-wire detonators. This assures a practically instant detonator action.

Typical high explosive mixes used in the shaped charge warheads are:

		composition (by weight)
Pentolite	PETN	50%
	TNT	50%

This material has a density of: ±1.0 gram/ml (granular form)
±1.65 gram/ml (in cast form)

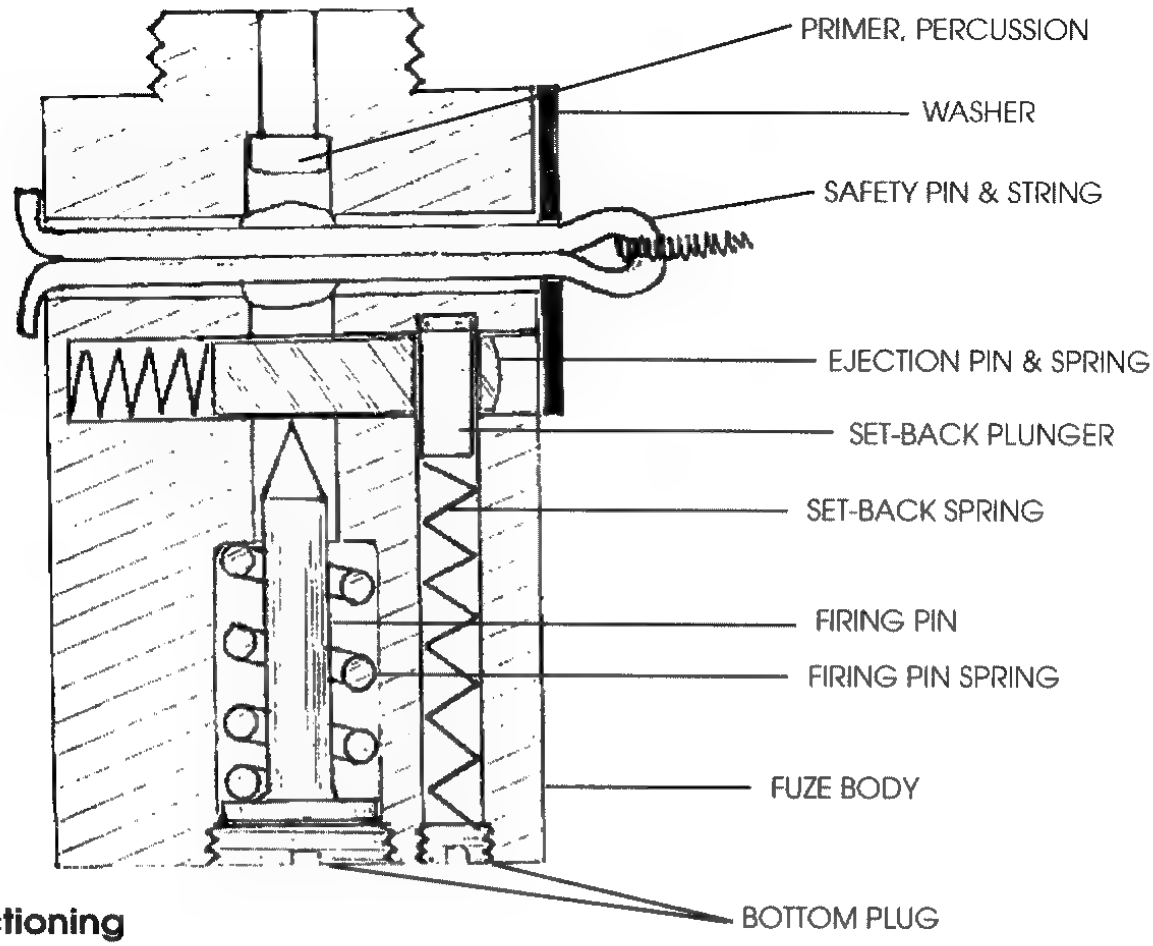
Detonation rate: 5500 m/sec (granulated)
7300 m/sec (cast)

Composition B	RDX	60 %
	TNT	40 %

Octol	HMX	75 %
	TNT	25 %

Pentolite, grade I, specification JAN-P-408 was used in the 2.36 inch M6A3 rocket. Although powerful, it is not as effective as the Composition B or Octol. Furthermore, in wet stage it is slightly corrosive to Copper, Zinc and brass. The composition B with a detonation velocity of 7800 rn/sec is used in a wide variety of explosive ammunition. It is powerful, stable, readily available and relatively easy to melt load. Octol, used in the M72 rockets has a detonation velocity of 8400 m/sec. Warheads with Octol filler have penetration and damage effect about 20% higher than the same warheads filled with composition B. Octol also allows a shorter standoff of shaped charges. However, at present the cost of Octol is about 3 times that of composition B. Both explosives are usually melt loaded at 90 ±3°C.

SCHEMATIC OF A MECHANICAL POINT-IMPACT NON-DELAY INERTIA FUZE FOR A HEAT WARHEAD



Functioning

1 - Safety pin is removed manually prior to loading of the projectile into the launcher.

2 - Upon firing the acceleration of the warhead forces the setback plunger back against the spring.

3 - This action releases the ejection pin; however, the pin cannot exit the fuze body because it is restrained by the launcher tube wall.

4 - Upon muzzle exit the ejection pin flies out of the fuze and the fuze becomes fully armed.

5 - Upon impact of the warhead against the target the inertia of the firing pin overcomes the spring force and the pin is driven into the primer, firing the detonator and the main charge.

Note: All elements are shown in a single plane to illustrate their relationship. In an actual fuze the components may be located along planes perpendicular to each other allowing for a compact and/or simpler assembly.

A simple mechanical fuze detonating on impact contains all, or most of the components described as follows:

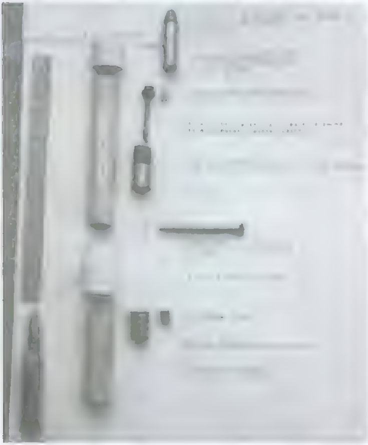
1 - Safety wire or strip - locks all other safety elements and must be removed manually.

2 - Setback pin and spring - this spring-loaded pin prevents the ejection pin from moving. During firing of the weapon the projectile is subject to sudden acceleration. The inertia of the setback pin forces it back against its spring. This movement allows the ejection pin to move partially out of the fuze body.

3 - Ejection pin and spring - when the setback pin disengaged, the ejection spring forces the ejection pin partly out of the fuze. Since the projectile is still inside the launcher this pin cannot fly out. Only after the projectile exits the muzzle can the ejection pin leave the fuze completely. The ejector pin and spring are also called "bore safety" element.

4 - Striker and spring - only after the ejection pin is out is the passage free for the striker (firing pin) to move forward. However, the striker is held back by the striker spring. The impact of the projectile nose against the target causes a sudden deceleration (of the fuze elements) . The striker inertia overcomes the spring force and allows the striker to hit and fire the primer.

Reenactment Fuze "M1V95" BD Instant



Note: 1- This fuze is so sensitive that a drop head-on on a hard surface will fire it.

2- To ignite the warhead's main charge requires a booster. For reenactment a three (3) gram pellet of black powder will expel the simulated main charge (of flour).

3- The plastic components are attached with appropriate adhesive at assembly; drill hole for safety wire before inserting the firing pin (nail).

4- An 8 penny nail with the tip cut off flat is suitable to remove fired primers from the .410 ga shotshell 3 inch long case.

5- The fuze safety nail is cut to fit the inside diameter of the launcher. It is secured by a strip of electrical tape or equivalent. During loading the tape is carefully removed while the safety is held by finger before insertion of the projectile into the launcher.

6- To assure positive and reliable primer ignition be sure that the firing pin (nail) strikes the center of the primer; use suitable washer and/or rubber sleeves for this purpose.

The warhead HEAT body is made from steel extrusion with walls about 2 millimeters thick. This requirement is dictated by the need to constrain and direct the filler explosion into a jet. If the body were made from a lighter and/or weaker material, such as sheet metal or plastic, the shaped charge would explode radially like a grenade. Although the reenactment warheads do not contain any high explosives, their overall weight is kept the same as the original HEAT component. This gives the reenactment item more reality in appearance and performance.

The reenactment warhead should be made from simple, readily available materials. The construction should not require extensive machining. The equipment should be restricted to such as is available in a typical household, i.e. electric hand drill, Skilsaw, a propane torch, and maybe a few plumbing taps and dies.

Following are a few work suggestions for how such a reenactment warhead may be constructed. For the body, use an empty soup can with the top removed and the edges rolled smooth. The bottom has a hole cut out to receive a standard male-female plumbing coupling screwed in and retained by a nut.

The liner is made as follows. A piece of wood of a diameter equal to the diameter of the can (body) is shaped at one end to the cone with a rounded point thus forming a mandrel. The wooden piece is held in the vise so that the pointed end is straight up. Now cut a piece of cardboard (from a file folder, for example) and form it into a cone on the mandrel. Seal the cut edge with tape (masking, plastic, etc.) on both sides if necessary to make a strong bond. The standoff shield is made in a similar manner, but using a stronger cardboard is necessary. The standoff shield may be built up of several layers glued together, until the desired rigidity is achieved. More on the standoff shield strength later.

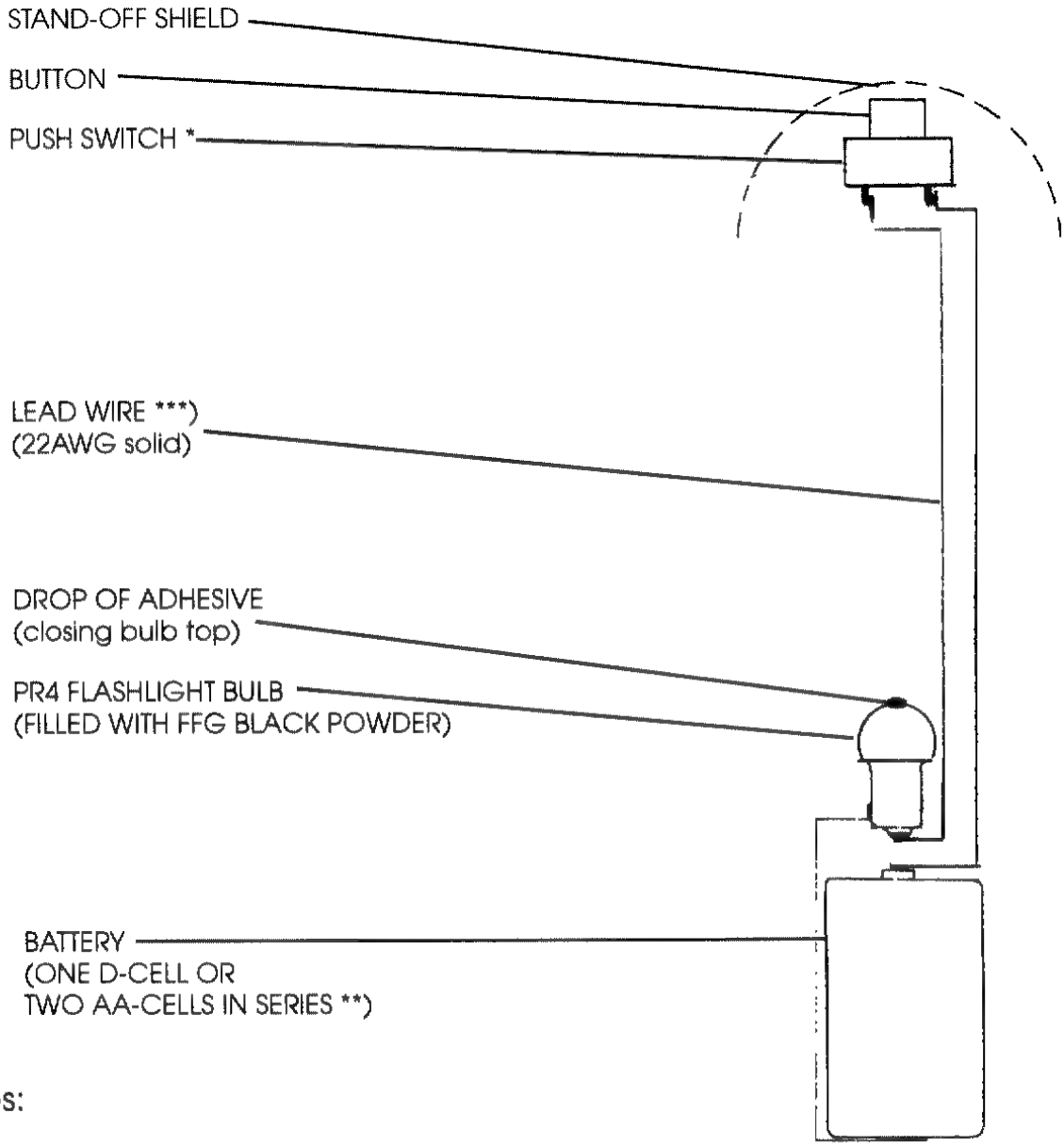
The reenactment warhead is assembled in the following manner: The liner is placed on the top (open end) of the body and secured with a tape and/or epoxy adhesive. Allow sufficient time for the adhesive to dry before checking the strength of the joint. If the liner is well secured, place the standoff shield over the body top and secure it with tape and epoxy adhesive.

If an electric nose fuze is to be used, the assembly order must be modified. The fuze is glued into the standoffs shield nose and the lead wires are carried through the warhead body, before the liner is placed in. A little slack in the wires is acceptable and will not affect the performance.

Now that the "metallic" parts are assembled, place the warhead upside down into a suitable holder which will keep the warhead without damaging the standoffs shield. A tall glass jar or a ring with a stand will be acceptable. Do not use a vise.

A good reenactment filler is talcum powder or flour with some bright red or orange pigment added. It will give a visible spot on the impact. A handmade paper funnel is inserted into the warhead body base. The filler is then spoon loaded into the body. Holding the warhead in one hand and gently tapping the body will assure a tightly packed filler. After the body is full to the bottom of

REENACTMENT WARHEAD ELECTRIC FUZE



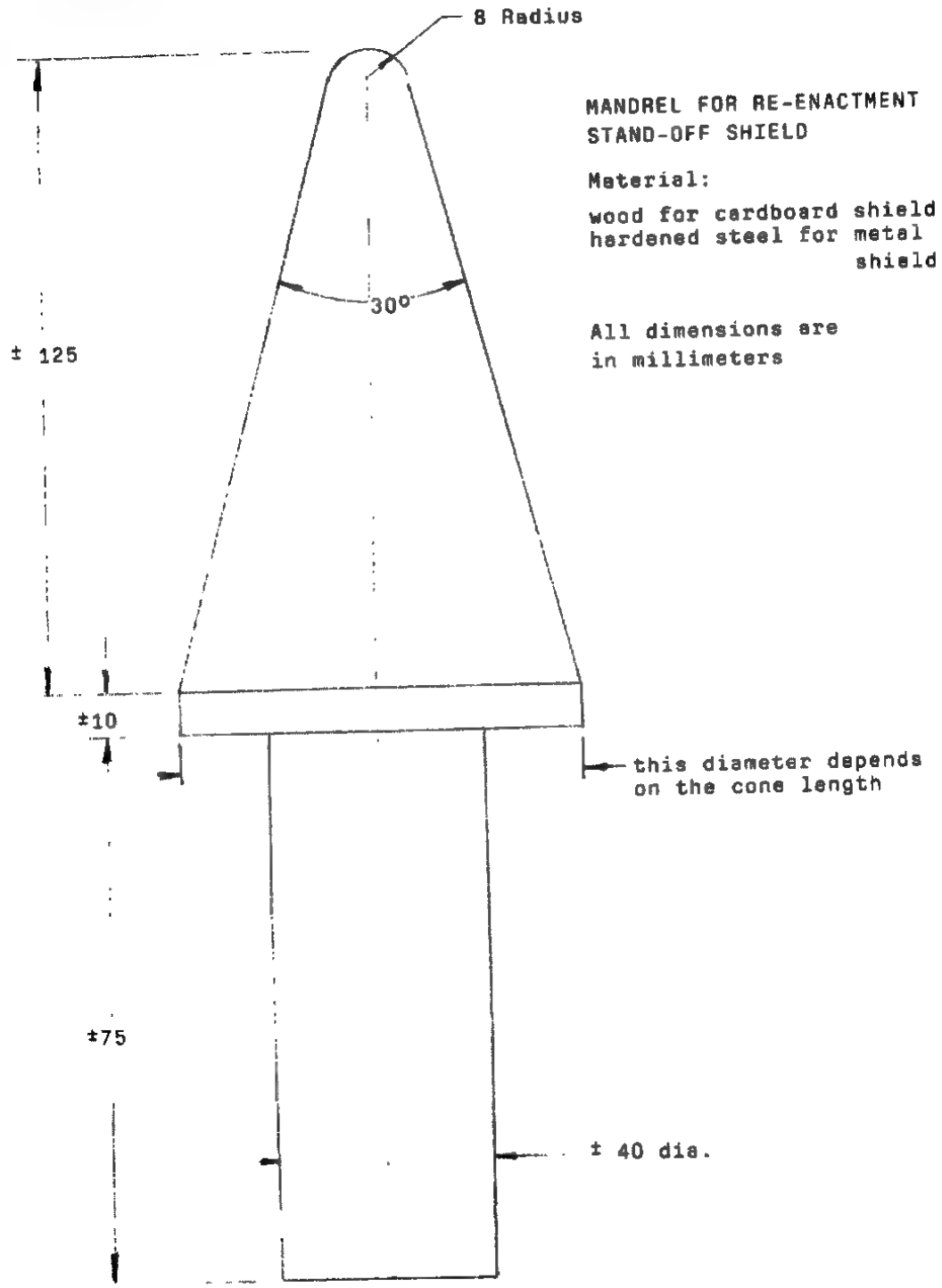
Notes:

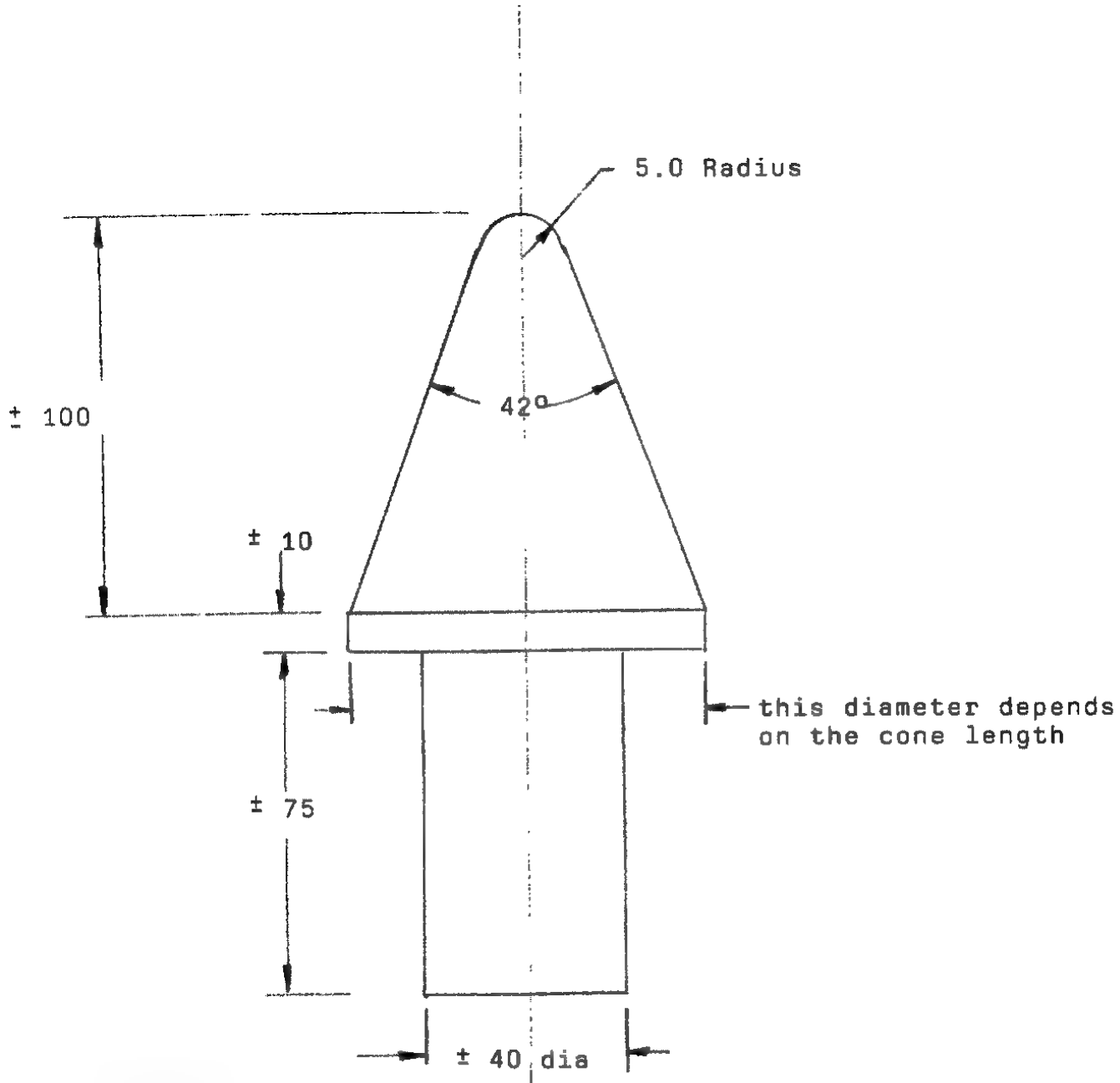
*) The switch must be tested with a dummy warhead to assure that the button does not compress the switch spring (and close the circuit) during warhead acceleration at firing of the rocket.

**) Two AA-cells weigh 46 grams vs. 135 grams of one D-cell; a suitable holder for the AA-cells is made from a strip of paper rolled on a 9/16 dia. wooden pin, and kept from unrolling by a piece of adhesive tape. Such a holder is light, yet sufficiently strong to keep the cells in place during projectile travel.

***) Solder all contacts for secure and positive connections.

the threads, remove the paper funnel and place a close fitting disc of wax paper over the filler. A small charge of black powder (3-4 grams) is then poured over the disc. Another close fitting wax paper disc is then seated over the powder. This disc is further secured by a small bead of adhesive (Elmer's glue, etc.) around its entire periphery. The reenactment warhead is now ready for assembly with the reenactment detonator and rocket motor units.

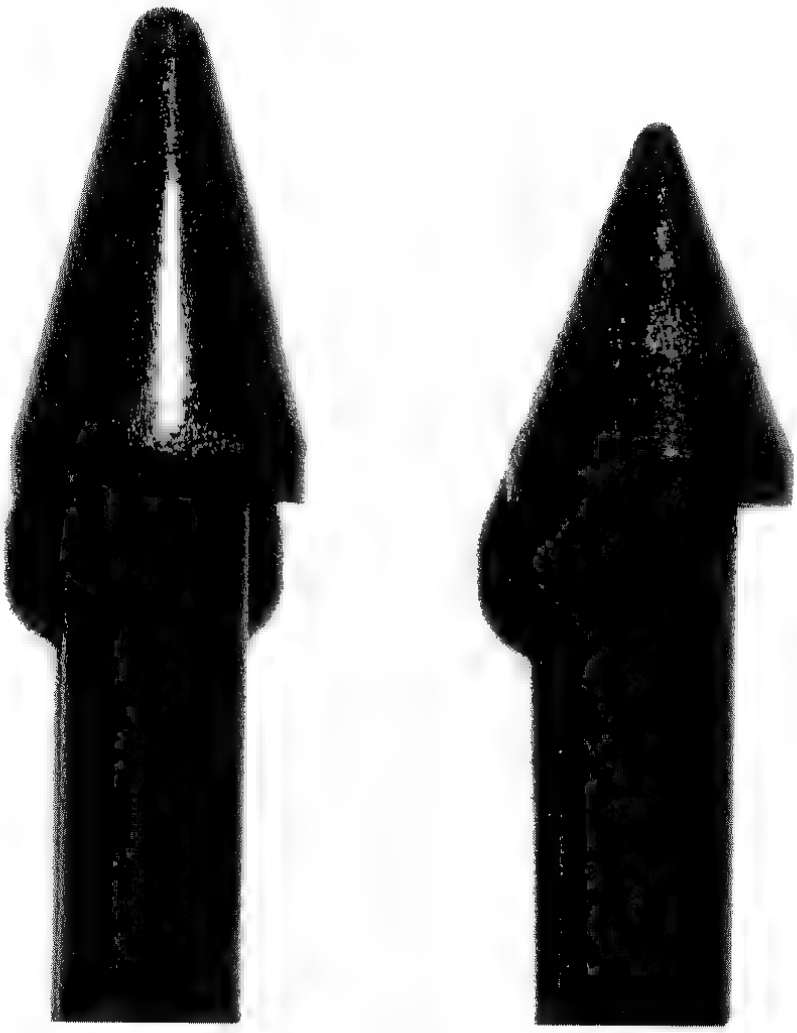




MANDREL FOR RE-ENACTMENT WARHEAD LINER

Material: wood for cardboard liner
hardened steel for copper liner

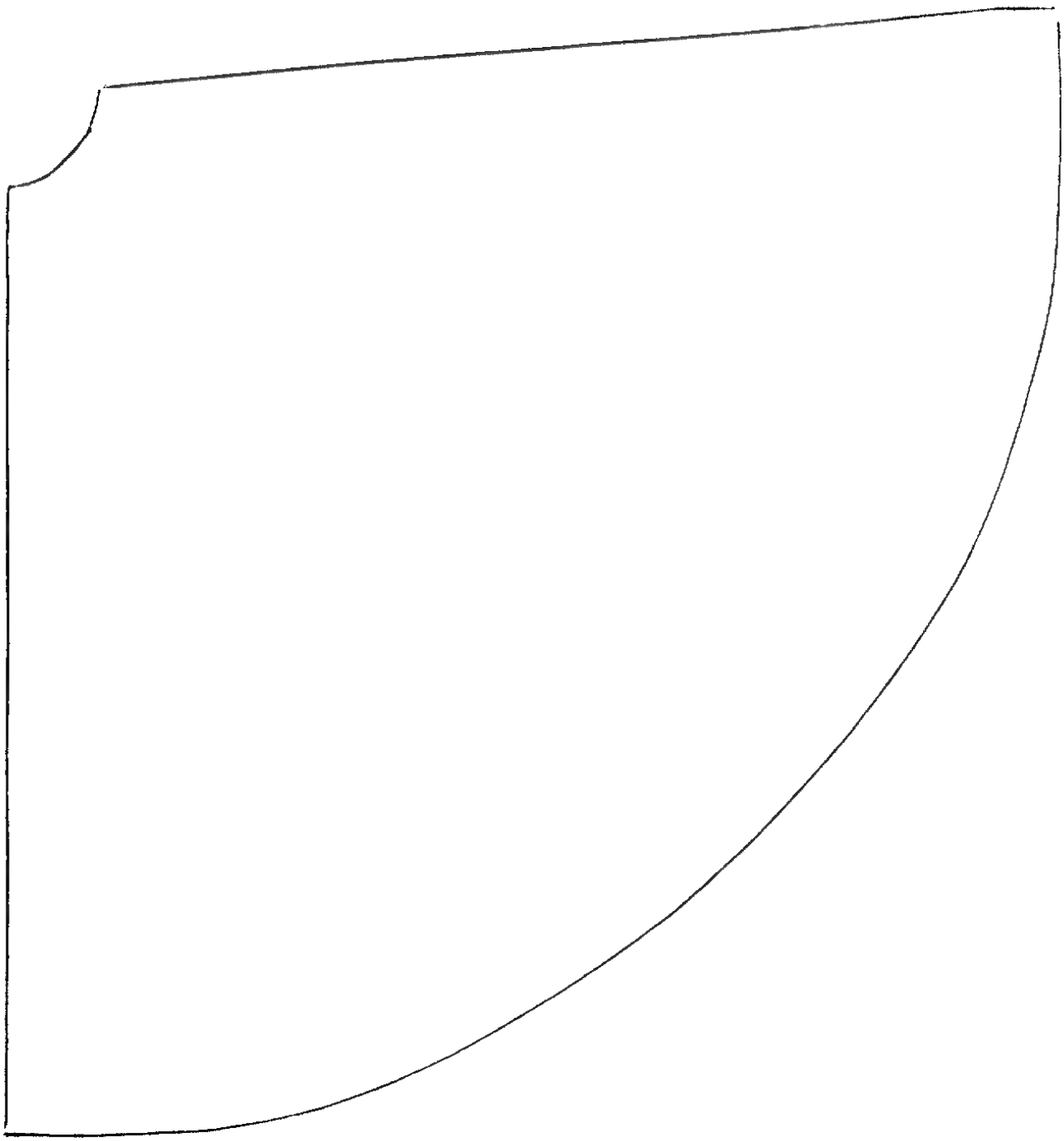
all dimensions are in millimeters



HEAT Warhead Mandrel

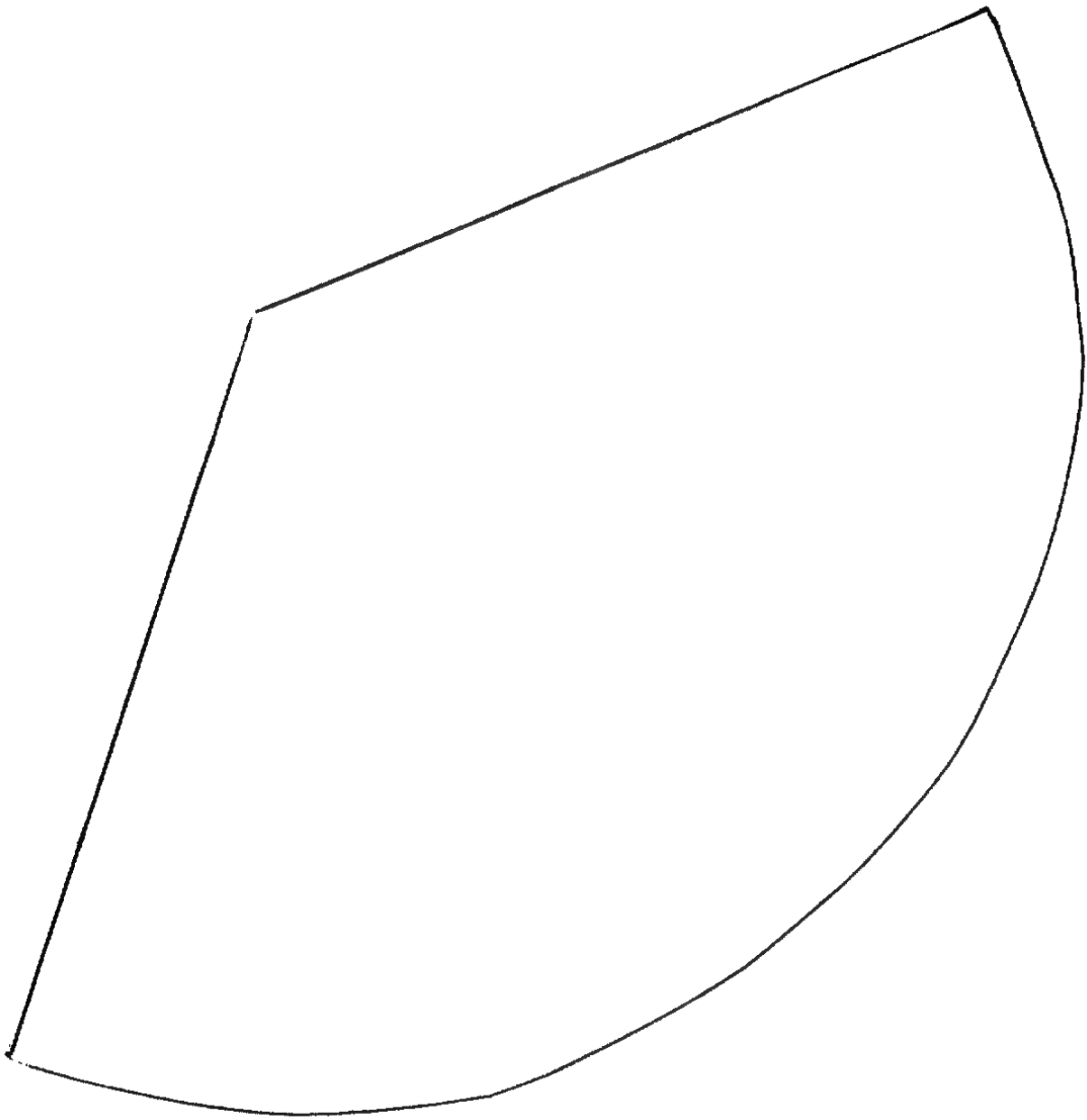
Left - Liner Right - Shield

PATTERN FOR STAND-OFF SHIELD FOR A RE-ENACTMENT MILK CAN SIZE WARHEAD



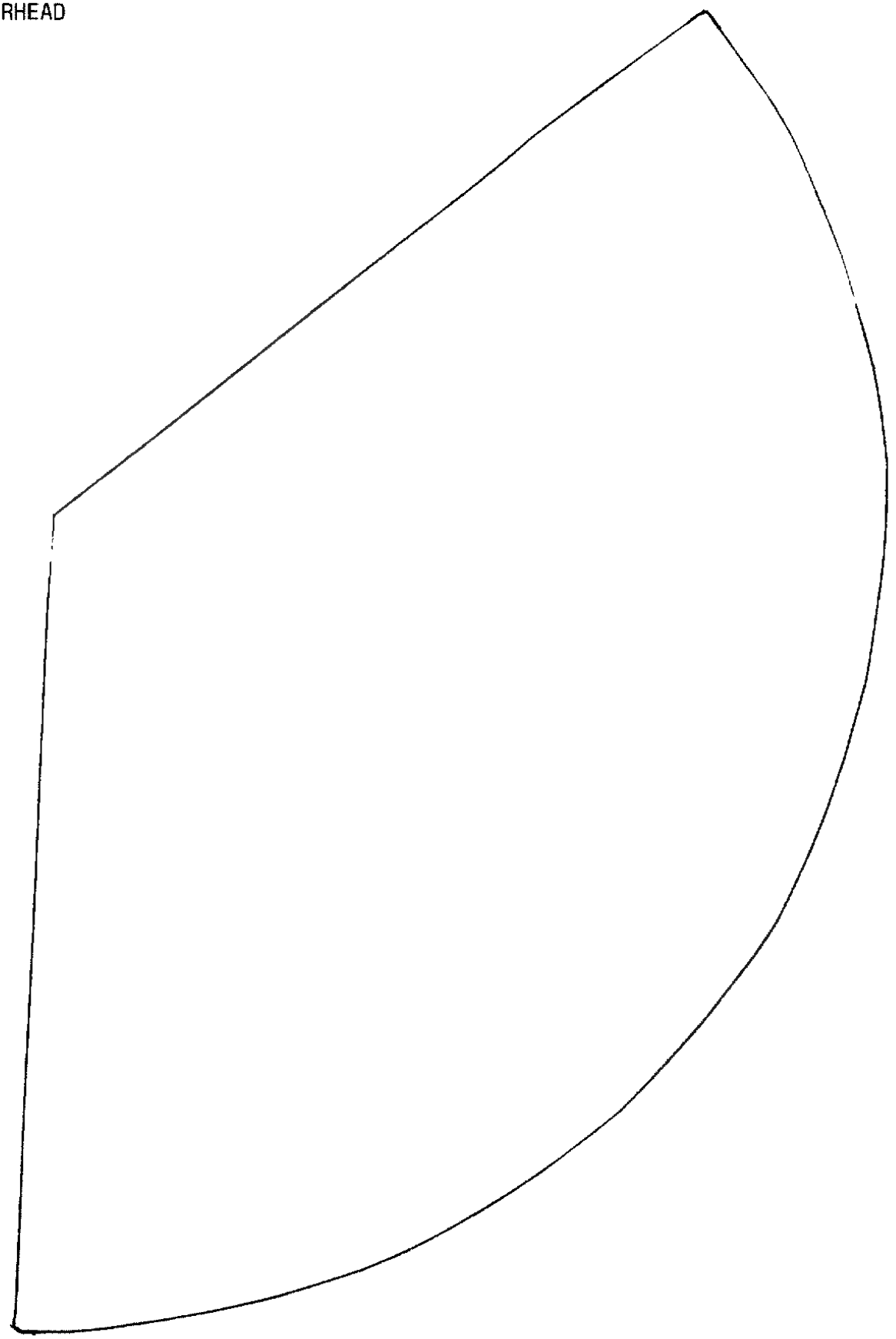
Pattern for stand-off shield for a reenactment milk can size warhead

PATTERN FOR LINER OF A RE-ENACTMENT MILK CAN SIZE WARHEAD



Pattern for liner of a reenactment milk can size warhead

PATTERN FOR A STAND-OFF SHIELD FOR A RE-ENACTMENT BEEF HASH CAN PANZERFAUST WARHEAD



Pattern for a stand-off shield for a reenactment Panzerfaust Warhead

Chapter IV

The Bazooka

The first successful individual weapon firing a shaped charge antitank warhead was the U. S. ARMY model M-9 2.36 inch rocket launcher commonly called Bazooka. The basic launcher, with minor modifications and the use of aluminum alloy components resulted in the Model M-18. During the Korean War the Bazooka underwent a major redesign which resulted in the 3.5 inch M-20 series. This weapon remained in service of the U. S. and NATO forces until the late 1950's. Its performance remains formidable even today.

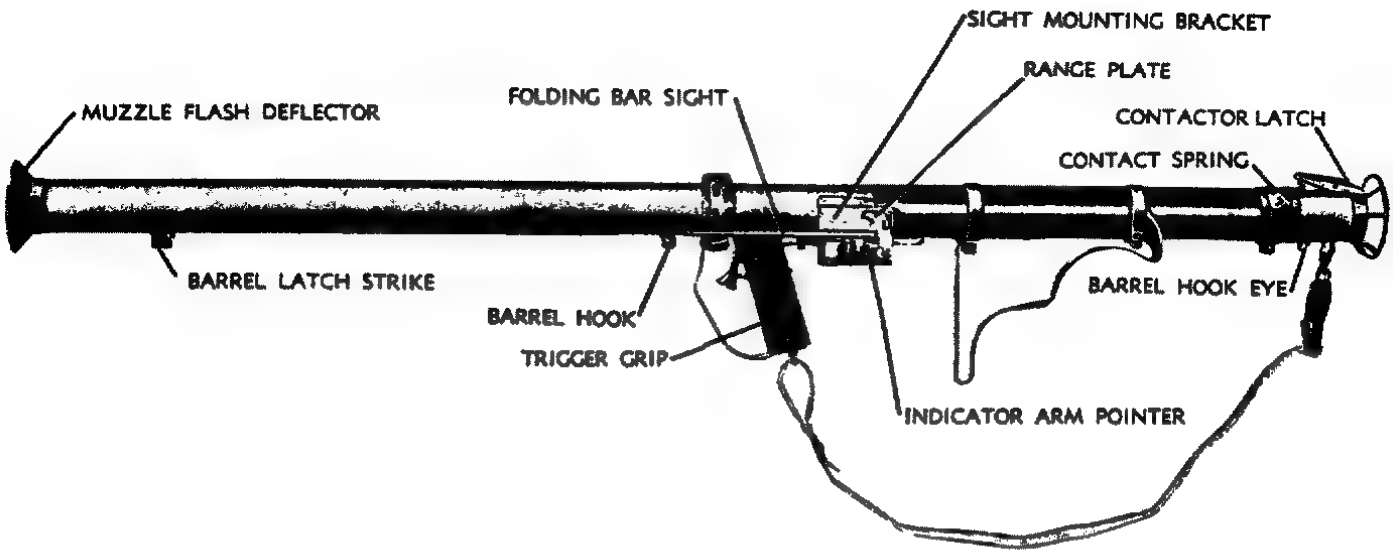
Some data of these models are given below.

Model	M-9	M-18	M-20
caliber of tube - mm	60	60	89
length of tube, folded - mm	800	800	760
ready to fire - mm	1550	1550	1330
weight of launcher- Kg	7.2	4.7	6.3
length of round- mm (HEAT)	495	495	600
length of warhead - mm			270
weight of round- Kg	1.57	1.57	4.1
weight of warhead- Kg	0.9	0.9	2.05
velocity, maximum-m/sec	82.5	82.5	102
range, maximum-m	550	550	830
range, effective-m	250	250	275
armor penetration at 0° - mm			280
firing mechanism	magneto	magneto	magneto
danger zone to rear of launcher - m			70

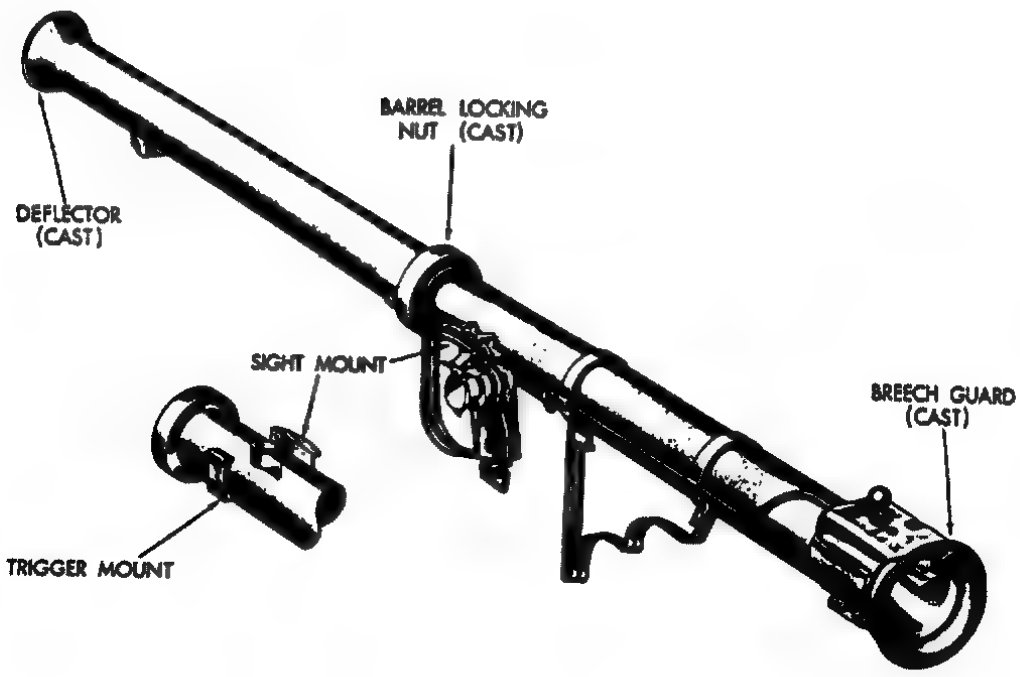
The propelling system of the Bazooka can be visualized as a small diameter rocket (motor) fastened to the rear end of the shaped charge warhead. The motor itself consists of a high grade heat treated steel tube filled with multiple propellant grains.

The rear end of the motor is closed by a diaphragm to create a combustion chamber. After the hot gases from the burning propellant reach the desired pressure level, the diaphragm ruptures and the gases pass through the nozzle to the rear. This action forces the rocket body in the opposite direction.

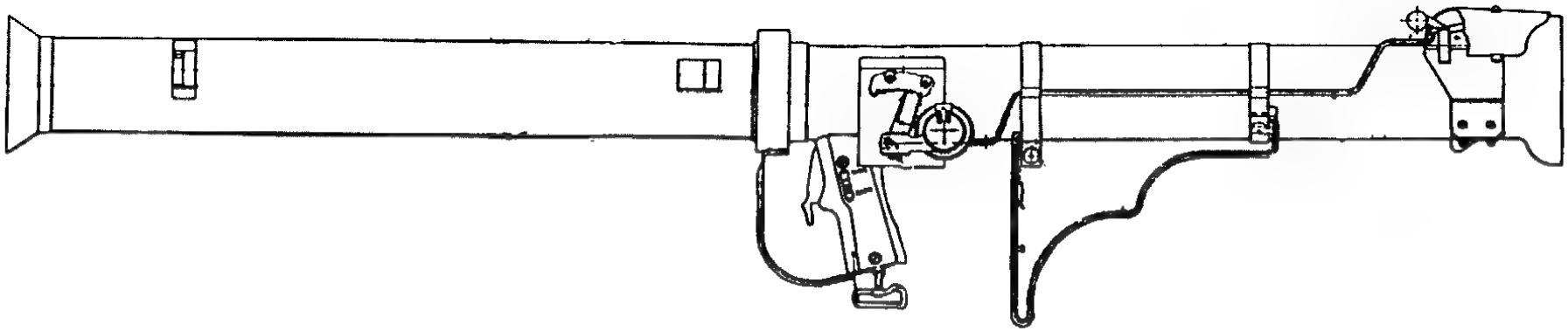
The Bazooka launcher is a steel tube (changed to aluminum in M-18) 61 inches long with an inside diameter of 2.37 inches. The ends of the tube are flared out to protect the tube body from dents which would prevent the entry and exit of the rocket. The launcher is equipped with a sight, pistol grip containing the firing mechanism and a skeleton shoulder support. The Bazooka is provided with a coupling device allowing the tube to be folded into two 31 inch sections. The model M-20 series launchers are enlarged and improved versions of the original M-9 model. The Bazooka is very effective, yet elegant by its simplicity. Following are some drawings showing the nomenclature and the details of the construction.



LAUNCHER,ROCKET, 2.36-INCH (60MM),M9



LAUNCHER,ROCKET,3.5-INCH(89MM),M20A1B1

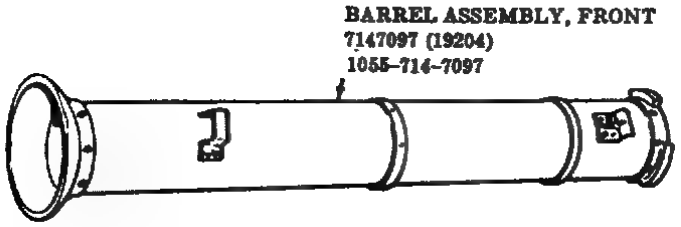


LAUNCHER, ROCKET, 3.5-INCH (89MM), M-20 SERIES

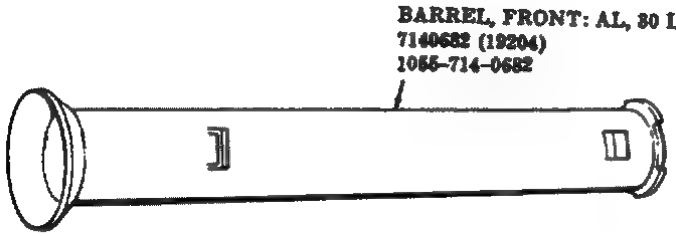
1055-575-0064 (M20)
1055-840-1841 (M20A1)
1055-840-1842 (M20A1B1)
1055-591-0217 (M20B1)

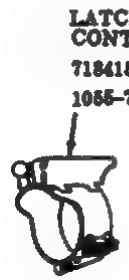
DIFFERENCES AMONG MODELS:

THE BARRELS OF THE M20 AND M20A1 ARE MANUFACTURED FROM ALUMINUM TUBE STOCK AND THE COMPONENT PARTS ARE FASTENED BY MEANS OF SCREWS. THE BARRELS OF THE M20A1B1 AND M20B1 ARE ALUMINUM CASTINGS AND MANY OF THE COMPONENT PARTS OF THE BARREL ARE CAST INTEGRAL WITH THE BARREL.

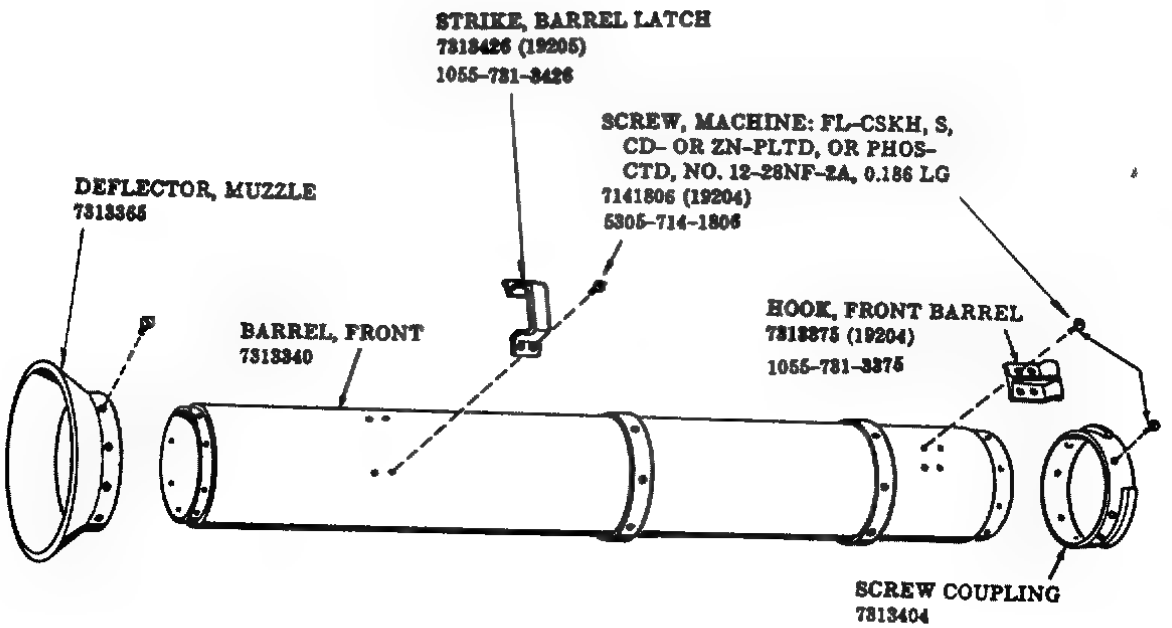


Front barrels and contactor latch assembly

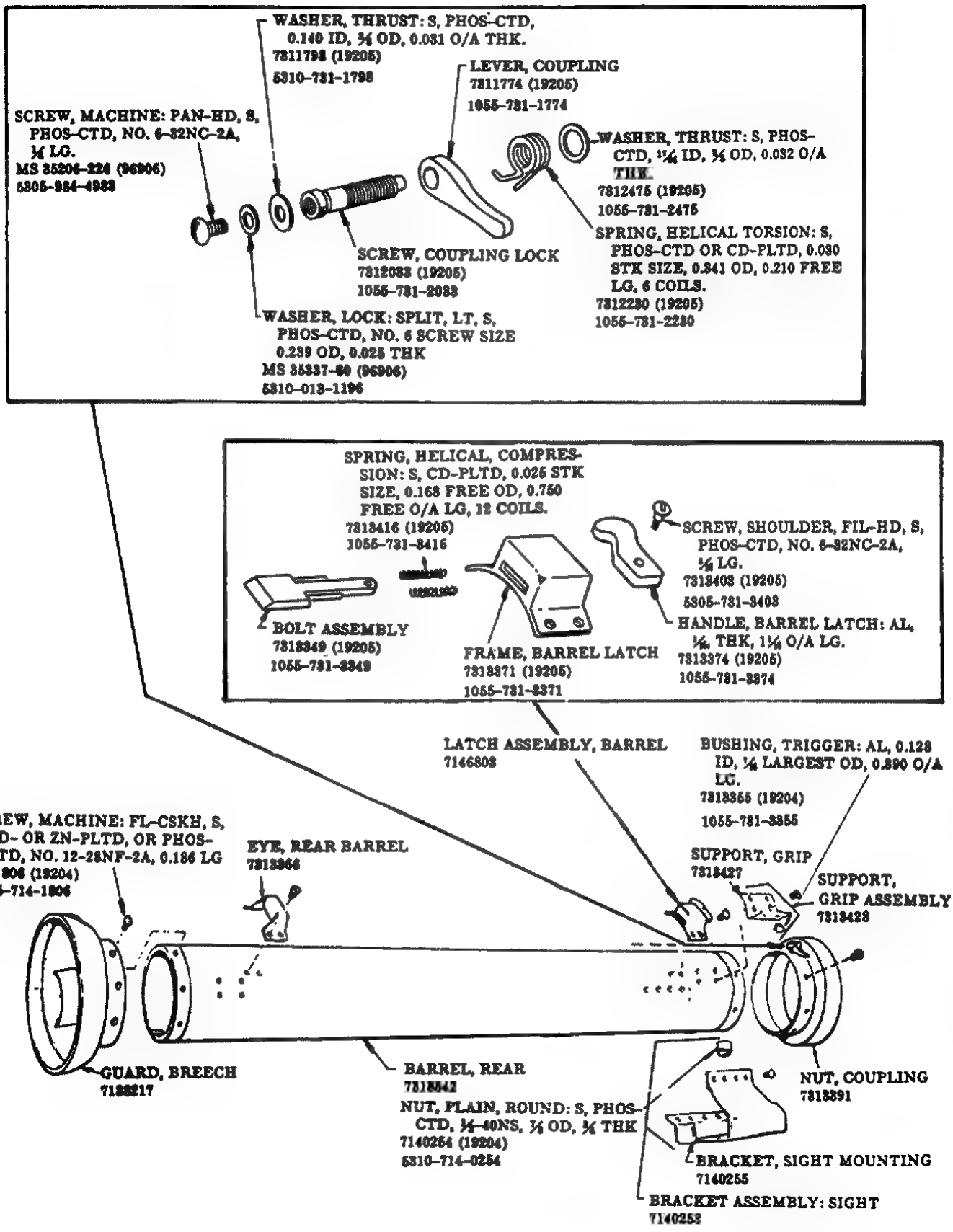




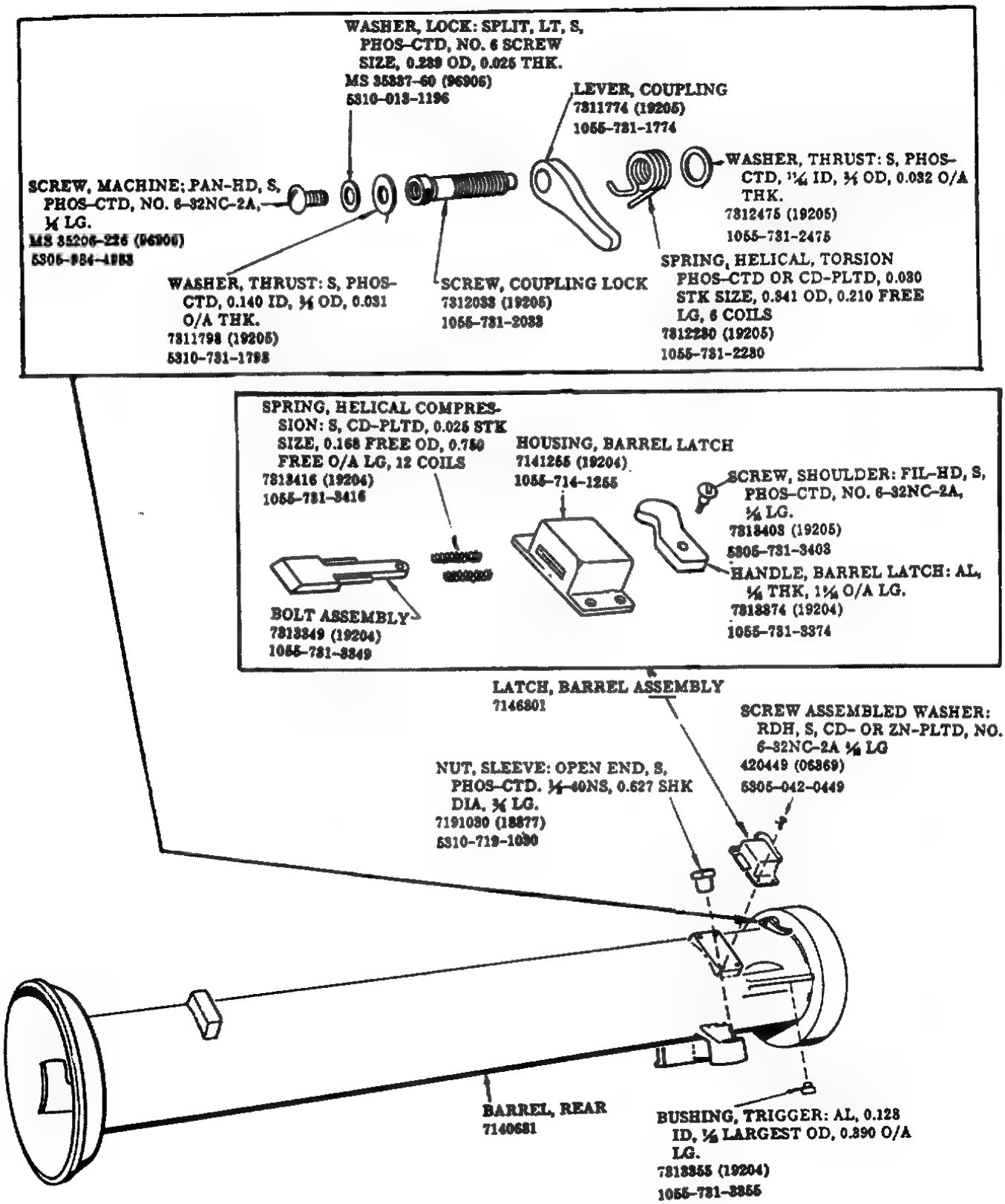
FRONT BARREL ASSEMBLY (M20A1 ONLY)

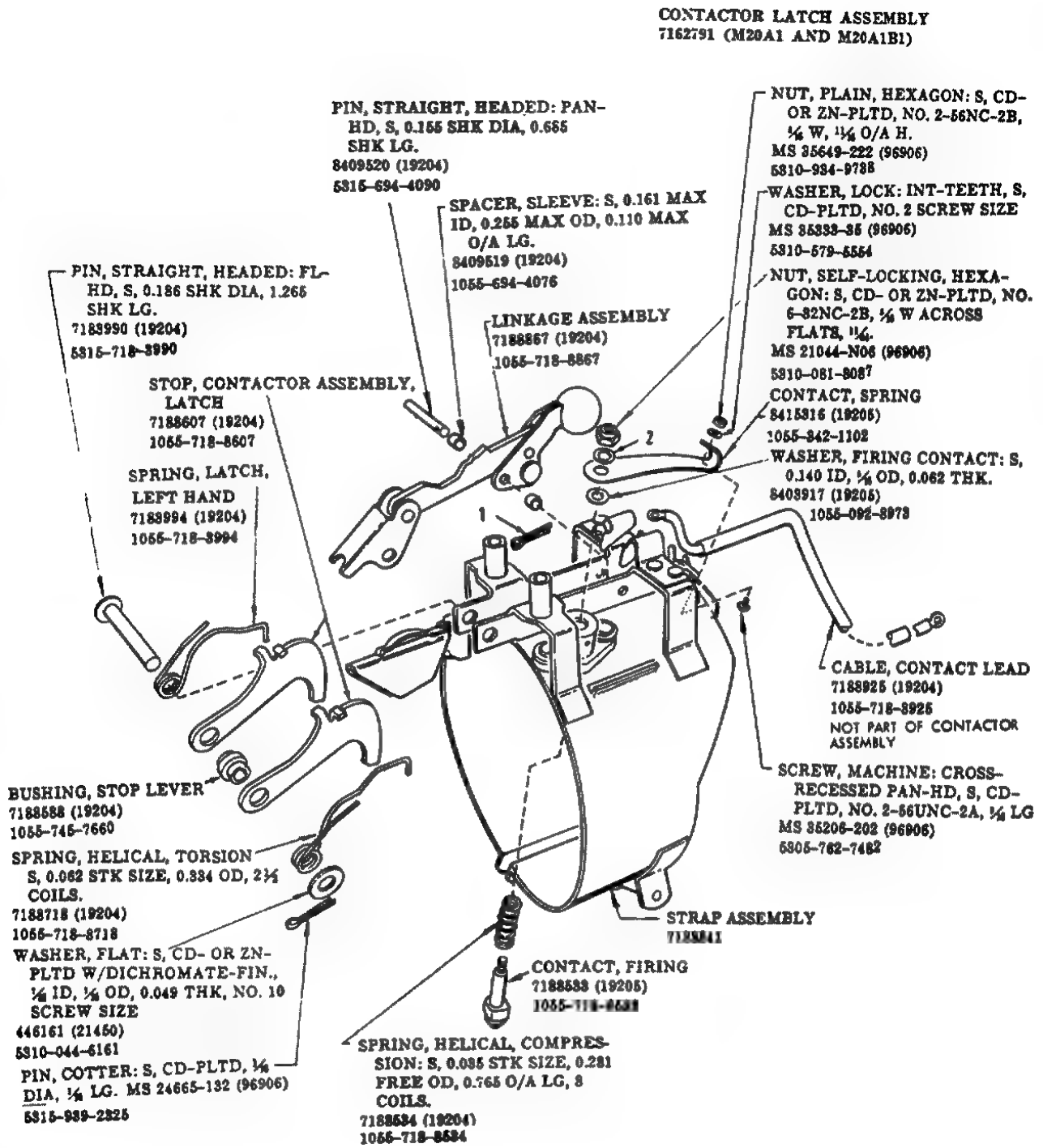


REAR BARREL ASSEMBLY
(M20A1 ONLY)



REAR BARREL ASSEMBLY
(M20A1B1 ONLY)

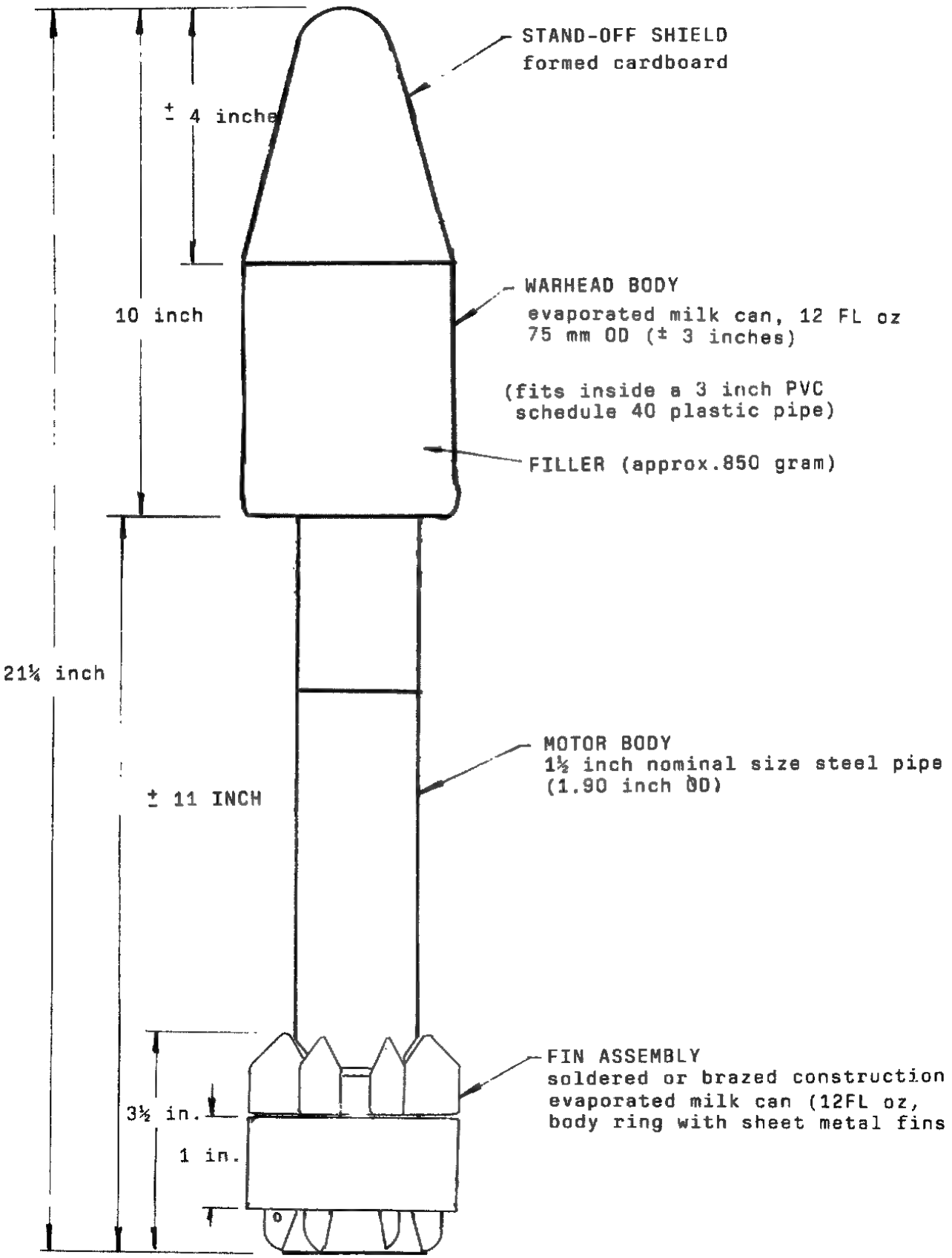


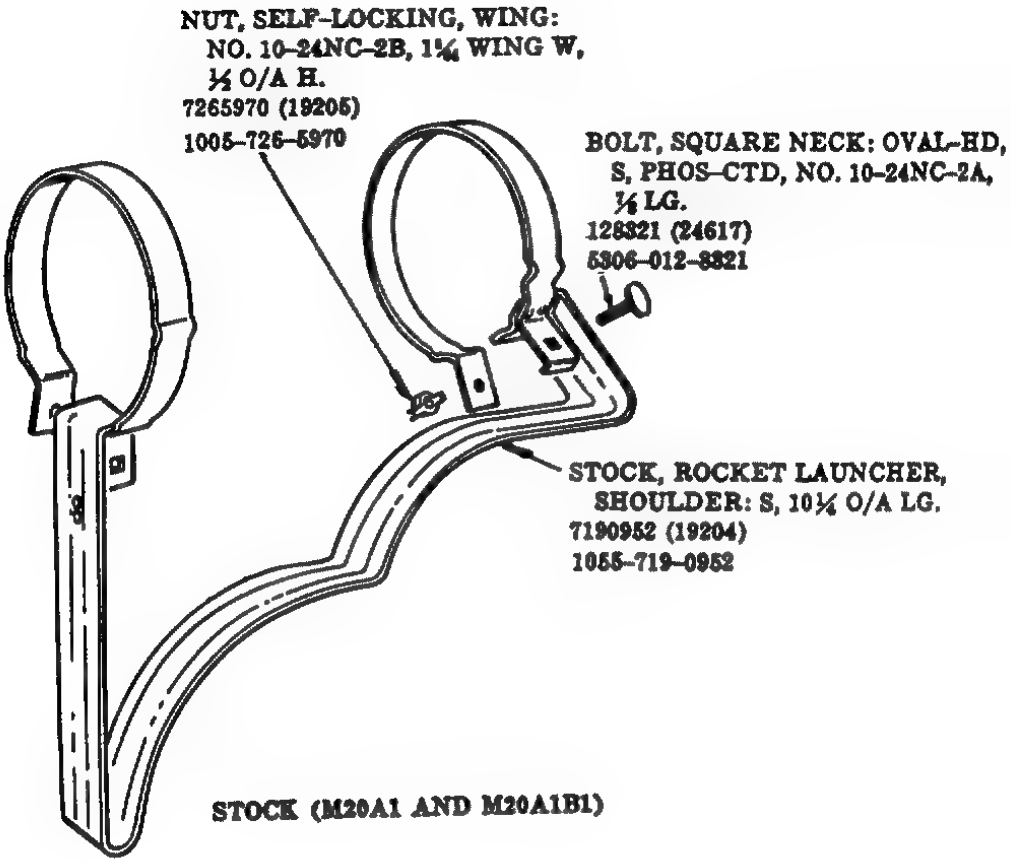


1 PIN, COTTER: S, CD-PLTD, 1/8 DIA, 1/8 LG.
MS 24665-132 (96906)
5315-989-2225

2 WASHER, LOCK: INT-TEETH, S, CD- OR ZN-PLTD W/CHROMATE-FIN., NO. 6 SCREW SIZE.
MS 35333-20 (96906)
5310-595-7235

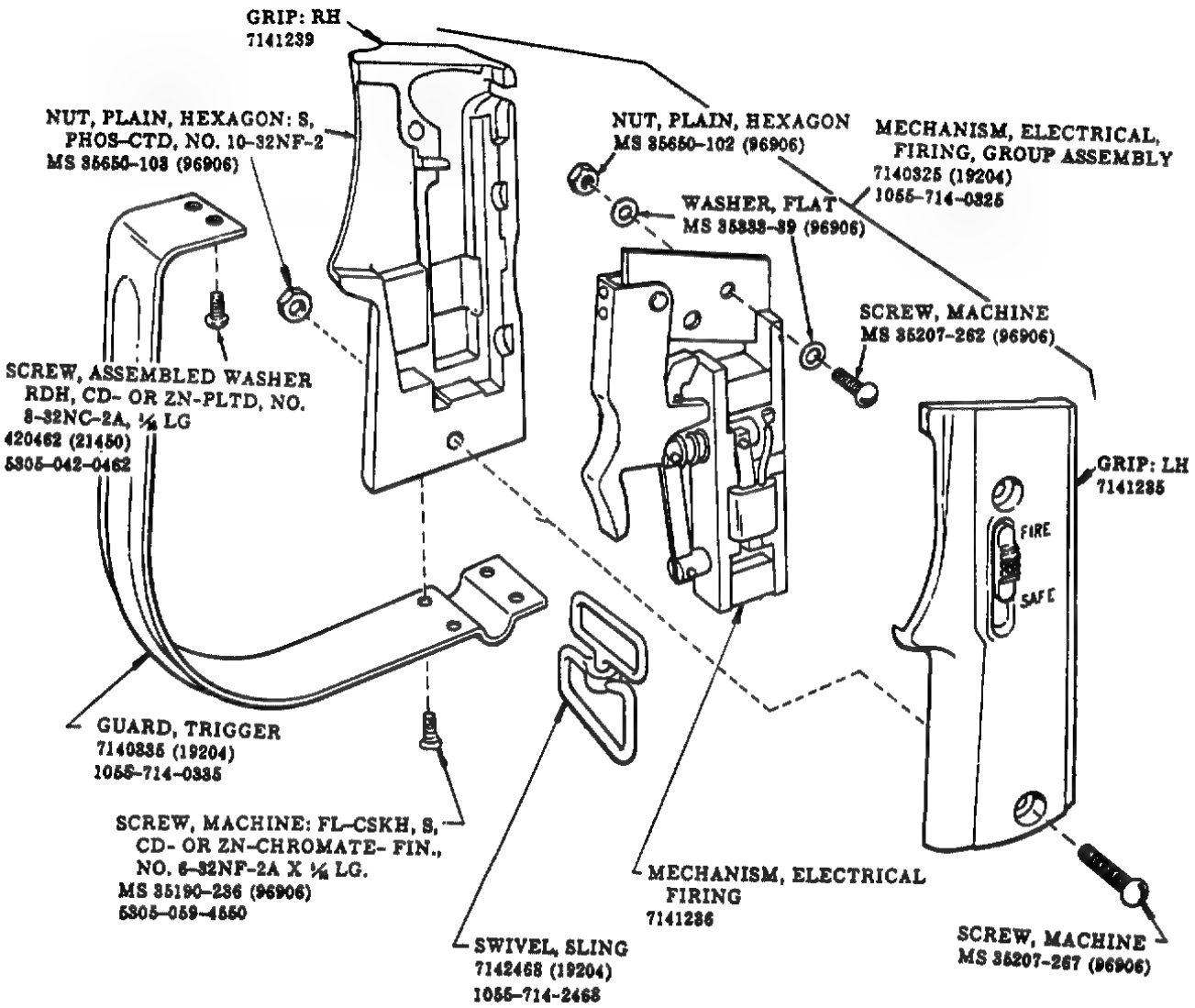
RE-ENACTMENT 3.5 INCH ROCKET M28A2





STOCK (M20A1 AND M20A1B1)

FIRING MECHANISM GROUP
(M20A1 AND M20A1B1)



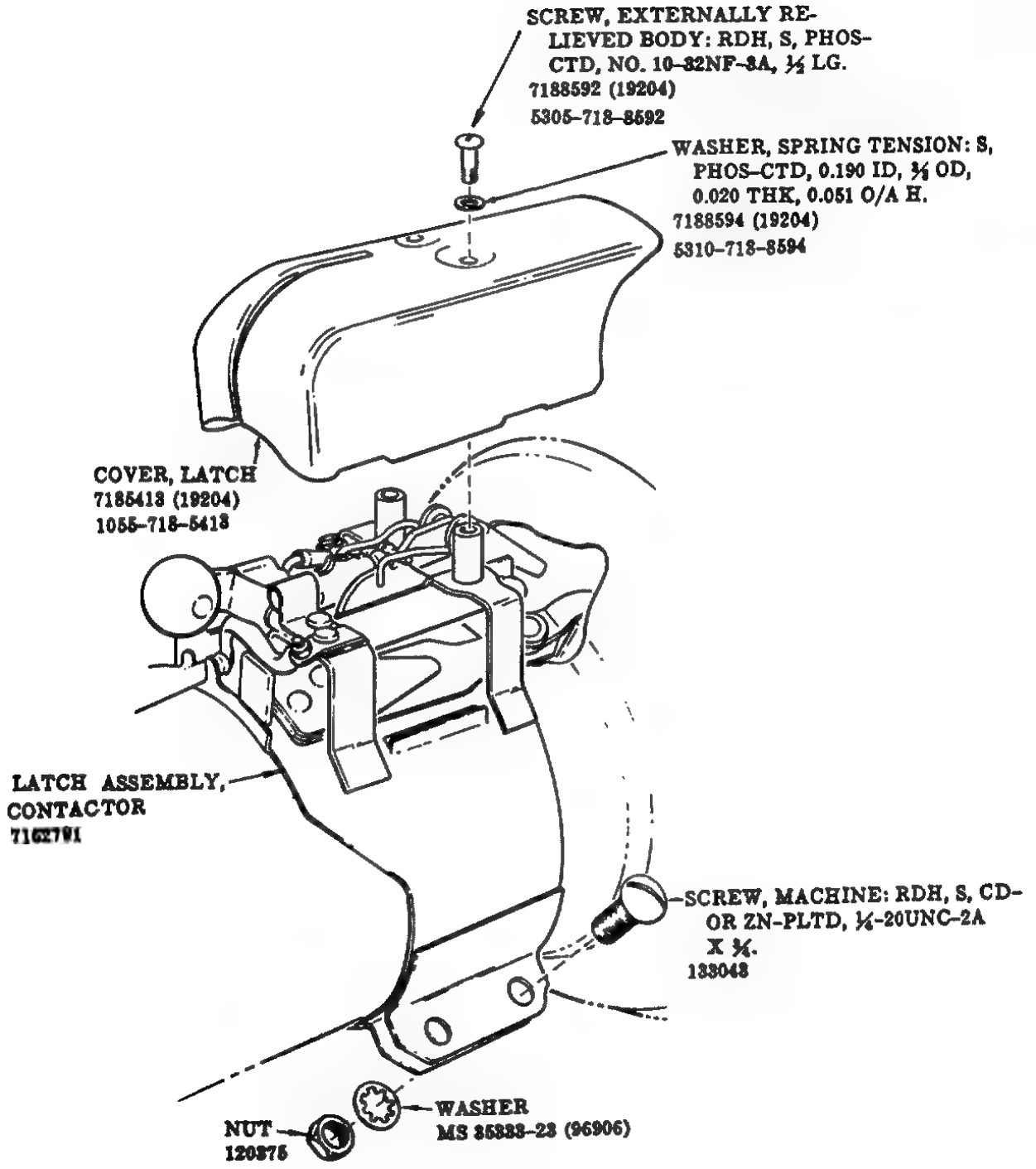
The Bazooka trigger mechanism conforms to the following requirements:

trigger pull , lbs. 7 - 14

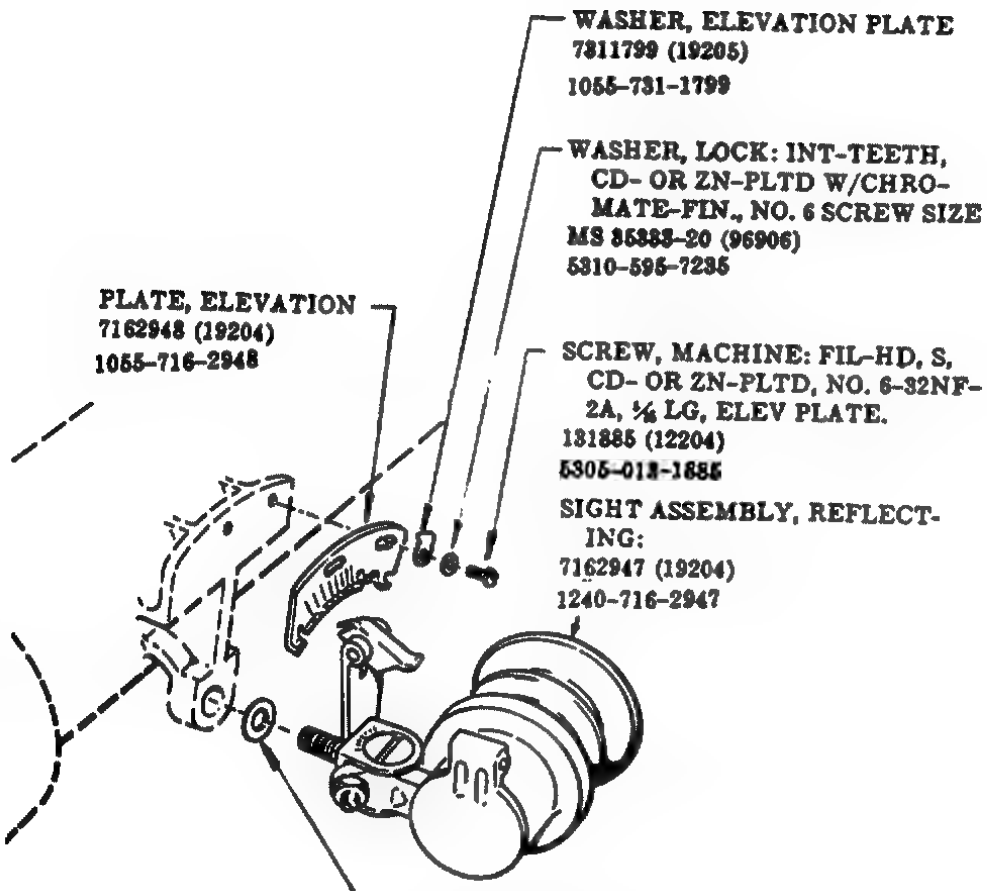
electric power generated - 48 milliwatt-seconds

electric firing system - 3 consecutive trigger pulls 30 seconds apart

CONTACTOR LATCH ASSEMBLY
7184159 (M20A1 AND M20A1B1)



REFLECTING SIGHT GROUP
(M20A1 AND M20A1B1)



REFLECTING SIGHT ASSEMBLY
7162947

MS 35691-422 (96906)
SETSCREW: SLOTTED, FL-PT, S, ZN-PLTD DICHROMATE DIP, ¼-28UNF, ⅝ LG.
MS 51031-62 (96906)
5305-054-1820

STUD, HINGE SIGHT
7311793 (19205)
1055-731-1793

NUT, PLAIN, HEXAGON: S, CD- OR ZN-PLTD W/CHROMATE, ¼-28UNF-2B, ⅛ W ACROSS FLATS
5310-579-2163

SPRING, HELICAL, COMPRESSION: S, 0.035 STK SIZE, 0.203 SOLID OD, ¹¹⁄₁₆ FREE O/A LG
7311789 (19205)
1055-731-1789

COVER, LENS
7161552 (19204)
1055-716-1552

SEAT, BALL
7311784 (19205)
1055-731-1784

ARM AND LOCK ASSEMBLY
7187705 (19204)
1055-718-7705

BALL, BEARING: CRES, 0.187 DIA.
MS 19060-5 (96906)
3110-965-8485

LENS ASSEMBLY
7688579 (19204)
1055-344-2614

RING, EXTERNALLY THREADED: SLOTTED FACE DRIVE, BRZ, 1¼ STR BORE DIA, 1³⁄₁₆NS, 0.125 O/A LG.
7161551 (19205)
1055-716-1551

SPRING, HELICAL, COMPRESSION: S, PHOS-CTD, 0.038 STK SIZE, 0.161 SOLID OD, ¹¹⁄₁₆ FREE O/A LG, 4½ COILS
7161555 (19204)
1055-716-1555

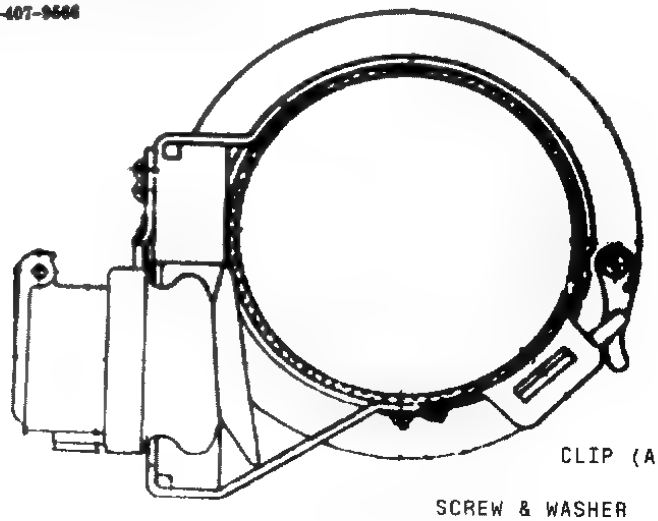
COVER
5182872 (19200)
6650-355-8920

SETSCREW: HDLS, FL-PT, S, PHOS-CTD, No. 5-40NC-2A, 0.250 LG.
7161550 (19200)
5305-716-1550

FRAME, LENS ASSEMBLY
7188065

WASHER, LOCK: SPLIT, LT, S, PHOS-CTD, ⅛ SCREW SIZE
MS 35338-45 (96906)
5310-407-9566

NUT, PLAIN, HEXAGON: S, PHOS-CTD, ⅛-40NS-2, ⅛ W, ⅛ O/A H.
7311776 (19204)
5310-731-1776



CLIP (A7313364)

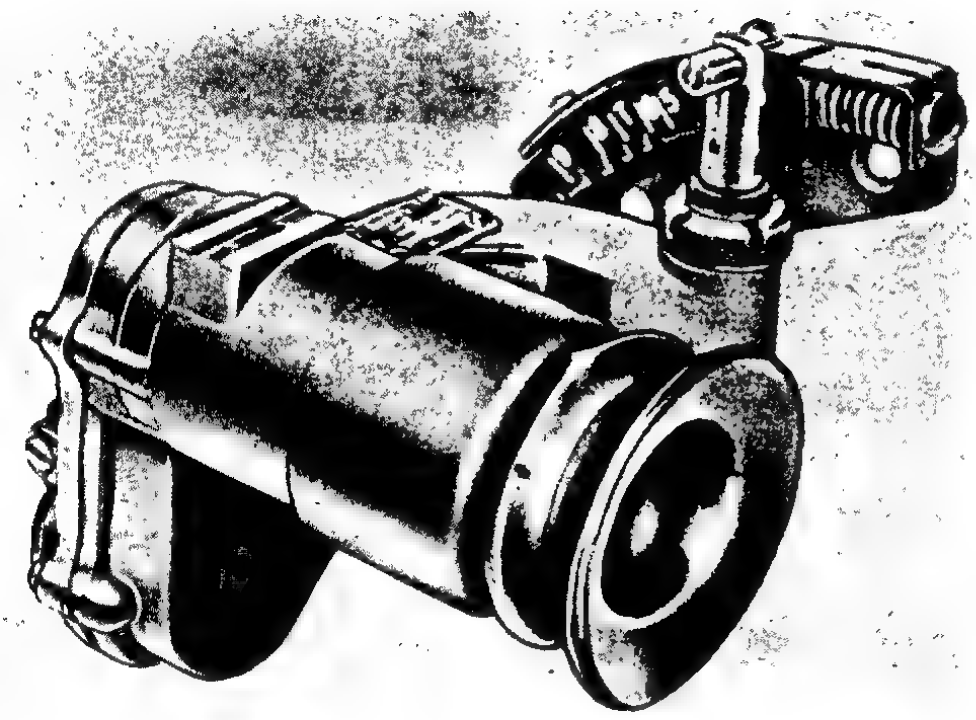
SCREW & WASHER

SIGHT ASSEMBLY
(Drwg.D7162947)

3.5 inch ROCKET LAUNCHER
(Drawing D7185425, section A-A)

SIGHT M39

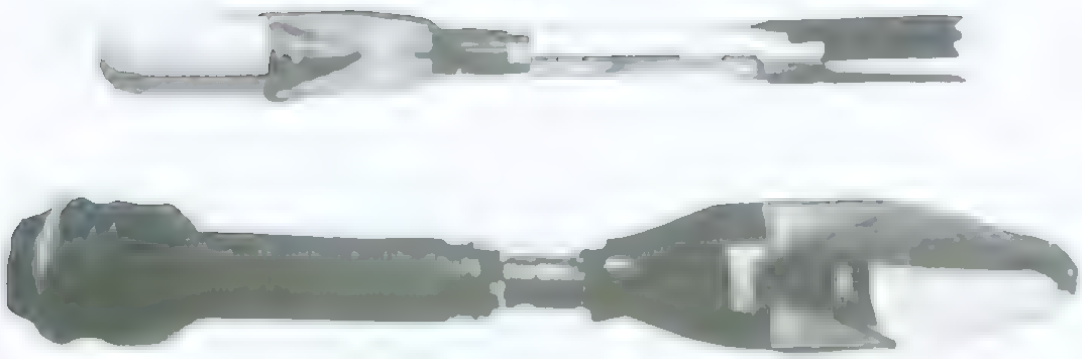
1240-346-8684



	TITLE	NUMBER
1	LAUNCHER ROCKET 35 M20AI	MIL L 696
2		
3		
4		
5	ALUMINUM-ALLOY (AL-17 BARS, RODS, SHAPES & WIRE	QQ-A 351
6	ALUMINUM ALLOY 24S;BARS, RODS, AND WIRE-ROLLED OR DRAWN	QQ-A 268
7	ALUMINUM ALLOY 24s, BARS, RODS AND SHAPES-EXTRUDED	QQ-A-267
8	ALUMINUM ALLOY (AL-24), PLATES, SHEETS & STRIPS	QQ-A-355
9	ALUMINUM ALLOY DIE-CASTINGS	QQ-A-591
10	ALUMINUM ALLOY, FORGINGS, HEAT-TREATED	QQ-A-367
11	ANODIC-FILMS; CORROSION PROTECTIVE, FOR AL ALLOYS	FXS-963
12		
13		
14		
15	BRASS, COMMERCIAL, BARS, PLATES, RODS, SHAPES, SHEETS AND STRIPS	QQ-B-611
16		
17	BRASS, LEADED AND NON-LEADED COPPER-ZINC ALLOY RODS,	
18	BARS, SHAPES, AND FORGINGS	QQ-B626
19	BRONZE, PHOSPHOR; BARS, PLATES, RODS, SHAPES, SHEETS, & STRIPS	AA-B-746
20		
21		
22		
23	CABLE, (HOOK-UP WIRE), ELECTRIC, INSULATED	JAN-C-76
24	CLEANING, PRESERVING, PACKAGING, PACKING AND MARKING OF	
25	SMALL ARMS SPARE PARTS	SAPD-1000
26	COMPOUND CORROSION PREVENTIVE PETROLATUM-TYPE,	
27	HOT APPLICATION	MIL-C-11796
28	COPPER BARS, RODS AND SHAPES	QQ-C-502
29	COPPER SILICON ALLOY, CASTINGS	QQ-C-593
30	COATINGS, PHOSPHATE,PROTECTIVE (FOR IRON AND STEEL)	MIL-C-12968
31		
32		
33	ENAMEL, SYNTHETIC LUSTERLESS	TT-E-527
34	ENAMEL, SEMI-GLOSS, RUST-INHIBITING	TT-E-485
35		
36		
37	FILMS CHEMICAL CORROSION PREVENTIVE FOR AL & AL	
38	-ALLOYS	MIL-C-5541
39	FINISHES, PROTECTIVE FOR IRON AND STEEL PARTS	57-0-2
40	FLUX, SOLDERING PASTE	Q-F-506
41		
42		
43		
44	GLASS FIBER; YARN, CORDAGE, SLEEVING, CLOTH AND TAPE	MIL-G-1140
45	GREASE, LUBRICATING, GRAPHITE	VV-G-671
46		
47		
48		
49	INSULATION; ELECTRICAL, SYNTHETIC-RESIN COMP, NON RIGID	MIL-I-631
50	IRON, MAGNETIC, BAR, SHEET, AND STRIP	MIL-I-11695
51		
52		
53		
54	LENS, REFLECTING SIGHT, ASSEMBLY	MIL-L10000
55	LUBRICATING-OIL,PRESERVATIVE, SPECIAL	JAN-L-644
56		
57		
58	MANUFACTURE AND INSPECTION OF SMALL ARMS WEAPONS AND	
59	ACCESSORIES	52-0-1
60	METALS, GENERAL SPECIFICATION FOR INSPECTION OF	QQ-M-151
61	PERMANENT MAGNET, SHAPES	QQ-M60
62	PHENOLIC (MOLDED SHAPES)	MIL-P-10420

63	PLASTIC-MATERIALS, LAMINATED THERMOSETTING RODS & TUBES	MIL-P 79
64	PLASTIC MATERIALS, LAMINATED THERMOSETTING SHEETS & PLATES	MIL-P-3115
65	PLASTICS, ORGANIC, GENERAL SPECIFICATIONS TEST METHODS	L P 406
66	PLASTIC, POLYSTYRENE, MOLDED	L-P-461
67	PLASTIC, POLYETHYLENE, MOLDED AND EXTRUDED SHAPES,	
68	SHEETS AND TUBING	MIL-P-3803
69	PRIMER, ZINC, YELLOW	3-201
70	PLATING,CADMIUM (ELECTRO DEPOSITED	OO-P-416
71		
72		
73	RUBBER & SYNTHETIC RUBBER COMPOUNDS, GENERAL PURPOSE	
74	(EXCEPT TIRE, INNER TUBES SPONGE RUBBER AND HARD RUBBER)	MIL-R-3065
75		
76		
77		
78	SOLDER, SOFT (TIN, TIN-LEAD, AND LEAD-SILVER)	QQ S-571
79	STEEL, ALLOY BARS (GENERAL PURPOSE)	QQ-S-624
80	STEEL, CARBON, BARS (GENERAL PURPOSE)	QQ-S-633
81	STEEL, CARBON, SHEET AND STRIP	QQ-S-640
82	STEEL, CORROSION-RESISTING, BARS, AND FORGINGS EXCEPT	
83	FOR REFORGING	QQ-S-763
84	STEEL, SPRING SPECIAL COLD ROLLED STRIP ANNEALED	SXS-160
85	STEEL, TOOL, ALLOY	QQ-S-778
86	STEEL, TOOL, CARBON VANADIUM	QQ-S-779
87	SURFACE ROUGHNESS WAVINESS AND LAY	MIL-STD-10
88		
89		
90		
91	TUBING, AL-ALLOY AL-24 AL-CU-MG-(1.5%) -MN, ROUND SEAMLESS	WW-T-785
92	TUBING, BRASS, LEADED, ROUND, SEAMLESS	57-191
93		
94		
95		
96	VARNISH MOISTURE-AND FUNGUS-RESISTANT FOR THE TREATMENT	
97	OF COMMUNI CATIONS, ELECTRONICS, AND ASSOCIATED	
98	ELECTRICAL EQUIPMENT	MIL-V-173
99		
100		
1 01		
102	WELDING, NOMENCLATURE AND DEFINITIONS	MIL-STD-20
103	WELDING OF CONSTRUCTIONAL STEEL, GAS, MANUAL OR MACHINE,	
104	FOR ARTILLERY AND SMALL ARMS MATERIAL EXCLUDING	
105	SUBMARINE MINES AND OBSERVATION TOWERS	52-206-11
106	WELDING OF CONSTRUCTION STEEL, RESISTANCE SPOT	57-206-21
107	WELDING SYMBOLS	JAN-STD-19
108	WIRE, MAGNET	JAN-W-583
109	WIRE, STEEL (CARBON), BARE & ZINC COATED	QQ-W-461
110	WIRE, STEEL CARBON, SPRING, MUSIC	QQ-W-470
111	WIRE, STEEL CORROSION-RESISTING	QQ-W423
112	WIRE, STEEL, SPRING, FOR SMALL ARMS WEAPONS	48-7-1

1	LIST OF DRAWINGS	D7185425 SHT 1
2	LIST OF SPECIFICATIONS	D7185425 SHT 2
3	SIDE VIEWS	D7185425 SHT 3
4		
5		
6	COMBINED LIST OF ALL PARTS & SPARE PARTS	D7145211
7	COMBINED LIST OF ALL PARTS & SPARE PARTS	D8237083
8	COMBINED LIST OF ALL PARTS, SPARE PARTS,	
9	EQUIPMENT AND TOOLS	D7189990
10		
11		
12		
13	DIAGRAM TARGETING	D7138250
14		
15		
16	ASSEMBLIES	
17	BARREL, FRONT ASSEMBLY	D7147097
18	SIGHT, REFLECTING, ASSEMBLY	D7162947
19	STOCK ASSEMBLY	D7190952
20	BARREL, REAR, ASSEMBLY	D7313343
21		
22	MECHANISM, ELECTRICAL FIRING, GROUP ASSEMBLY	C7140325
23	COIL ASSEMBLY, FIELD	C7141237
24	ARM AND YOKE ASSEMBLY	C7145540
25	LATCH CONTACTOR ASSEMBLY	C7162791
26	HANDLE CONTROL ASSEMBLY	C7185415
27	ARM AND LOCK ASSEMBLY	C7187705
28	LEVER ASSEMBLY	C7188566
29	LENS, REFLECTING SIGHT, ASSEMBLY	C7688579
30		
31		
32	BRACKET, SIGHT, ASSEMBLY	B77140253
33	GRIP, LEFT HAND, AND SAFETY ASSEMBLY	B7141235
34	MECHANISM, ELECTRICAL FIRING ASSEMBLY	B7141236
35	LATCH ASSEMBLY, BARREL	B7146803
36	LATCH, CONTACTOR, GROUP ASSEMBLY	B7184159
37	SPRING DETENT ASSEMBLY	B7185420
38	FRAME, LENS ASSEMBLY	B7188066
39	BRACKET, SLING, ASSEMBLY	B7188803
40	POST & FRAME ASSEMBLY	B7188830
41	STRAP ASSEMBLY (WELDMENT)	B7188841
42	LINKAGE ASSEMBLY	B7188867
43	CABLE, CONTACT LEAD ASSEMBLY	B7188925
44		
45		
46	PLATE, BACK AND BRACKET, ASSEMBLY	A7141227
47	TRIGGER AND SPRING ASSEMBLY	A7141228
48	LATCH ASSEMBLY	A7141229
49	RIGGER AND LATCH ASSEMBLY	A7141230
50	ARMATURE, SLEEVE AND SPRING ASSEMBLY	A7141231
51	LOOP AND BOSS ASSEMBLY	A7142467
52		
53	SWIVEL, SLING, ASSEMBLY	A7142468
54	SOCKET, ASSEMBLY	A7185421
55		
56	BOLT, BARREL LATCH, ASSEMBLY	A7313349
57	SUPPORT, GRIP, ASSEMBLY	A7313428
58	CONNECTOR ASSEMBLY	A8402353
59		
60	PACKING AND MARKING DRAWINGS	
61	LIST OF PACKAGED SPARE PARTS	



Top 2 36 inch HEAT M6A5 rocket Bottom 3 5 inch HEAT M28A2 rocket

2 36 inch HEAT M6A5 rocket warhead

The M6 series projectile consists of the HEAT warhead, fuze, motor with propellant, electric igniter and a nozzle and fin assembly. The basic components are shown below.

The 60 millimeter HEAT warhead is of the classic type with a steel body, ogive shaped stand-off shield, copper liner and Pentolite main charge. The warhead body base is fastened to a male threaded union.

The M4O1 fuze is a simple, non-delay, inertia actuated type. It consists of a detonator, percussion primer, spring restrained inertia firing pin and two safeties. One is a manual safety pin removed at loading, another is a bore-riding safety pin released by the set-back during firing and held in place by the launcher tube wall until the projectile leaves the muzzle. The fuze assembly is housed in the front portion of the rocket motor. The M401 fuze is extremely sensitive. A blow on the warhead nose equivalent to a 130mm (5 inch) drop on a hard surface will fire the warhead.

The M6 rocket motor is a seamless, heavy wall, steel tubing 31.7mm ($1\frac{1}{4}$ inch) outside diameter and 25.7 mm (1 inch) inside diameter with a wall thickness of 3.0 mm ($\frac{1}{8}$ inch). The front of the motor is a steel part brazed to the tube. It serves as the base for the detonator-striker assembly. The motor front end is threaded onto the warhead union piece. The motor nozzle is part of the fin assembly.

The initial M-6 series Bazooka rocket motor contained a single cylindrical propellant grain 22 millimeters in diameter with a 6 millimeter hole through the center. This grain configuration gave a slow burning rate, particularly at low temperatures. The grain continued to burn even after exit from the launcher with the gases burning the shooter's face. Subsequently the propellant was modified. The new charge consisted of five individual grains of $9\frac{1}{2}$ millimeter diameter with a 1.6 millimeter hole in center. The chemical composition was a modification of a conventional double-base powder and was called "Blastless Bazooka Propellant" (BBP) type M-7.

The M-7 propellant composition is:

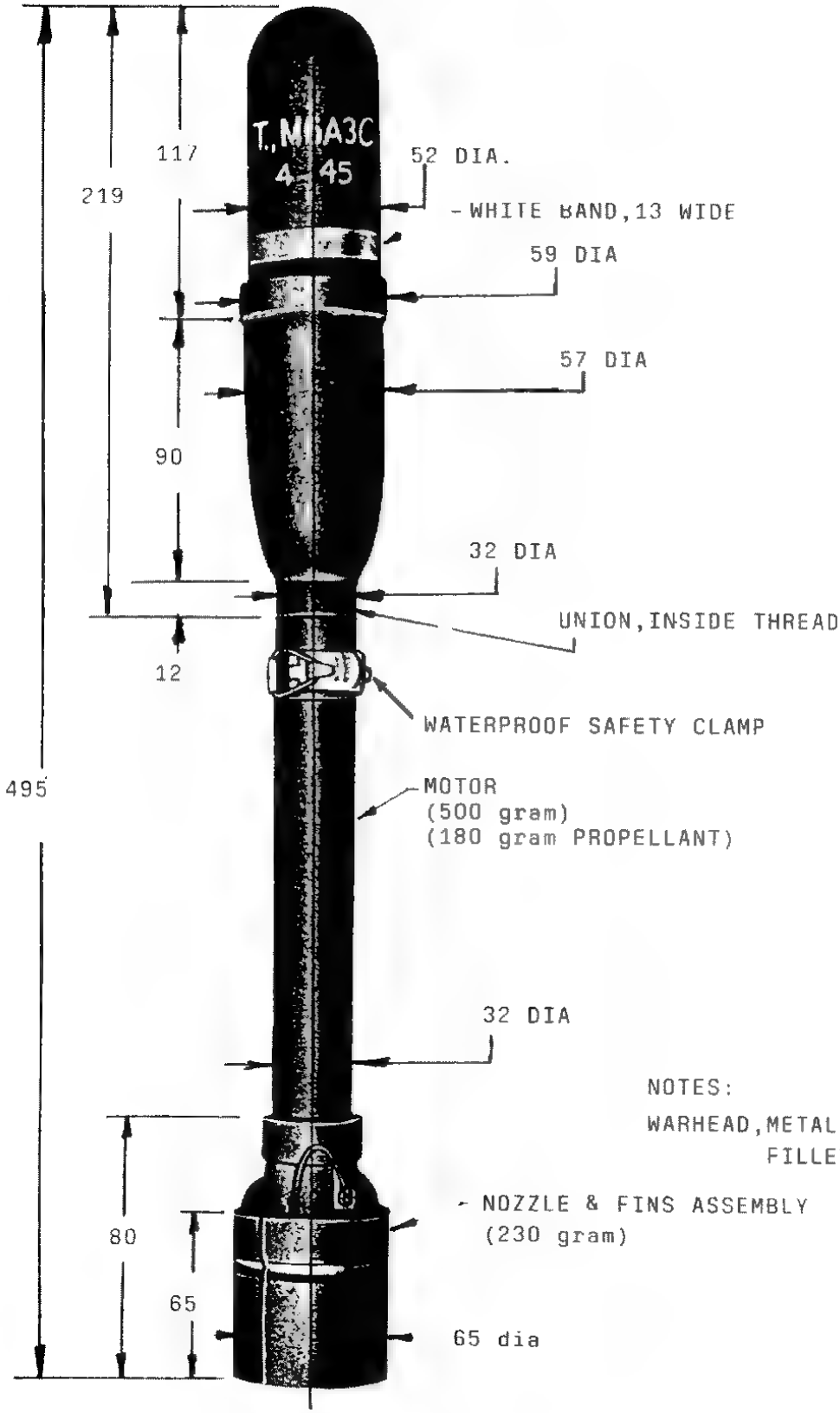
Material	% by weight
Nitrocellulose	54.6
Nitroglycerine	35.5
Potassium chlorate	7.8
Carbon black	1.2
Ethyl centralite	0.9

While the M-6 series rocket motors were expected to operate at 500 Atmospheres (about 7500 psi), the later rocket motors were operating at 700 Atmospheres (10000 psi) and even 900 Atmospheres (13000 psi). For comparison, modern shotguns are proof fired at 900 Atmospheres and U. S. commercial shotshells operate at 700 Atmospheres.

The electric igniter is held by a plastic nozzle cup inside the nozzle and fin assembly. One of the igniter wires is soldered to a fin (ground) while the other (hot) is connected or leading to the launcher electric current (positive).

The nozzle and fin assembly consists of aluminum nozzle, six fins and a capillary tube all welded together. This assembly with the igniter seated in, is screwed into the rear end of the rocket motor.

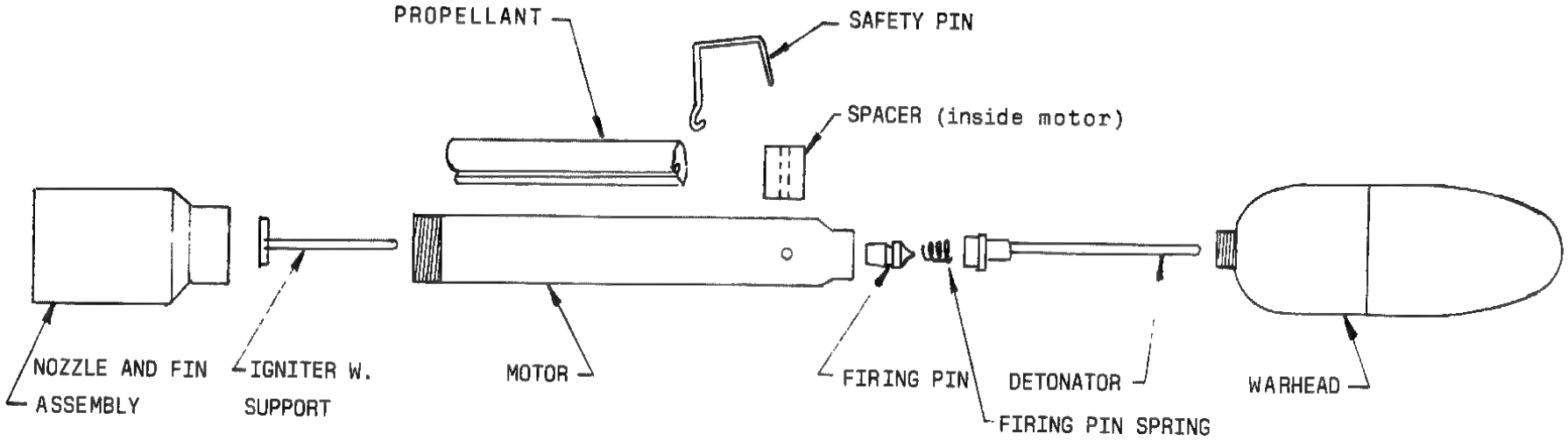
2.36 INCH HEAT ROCKET M6A3C



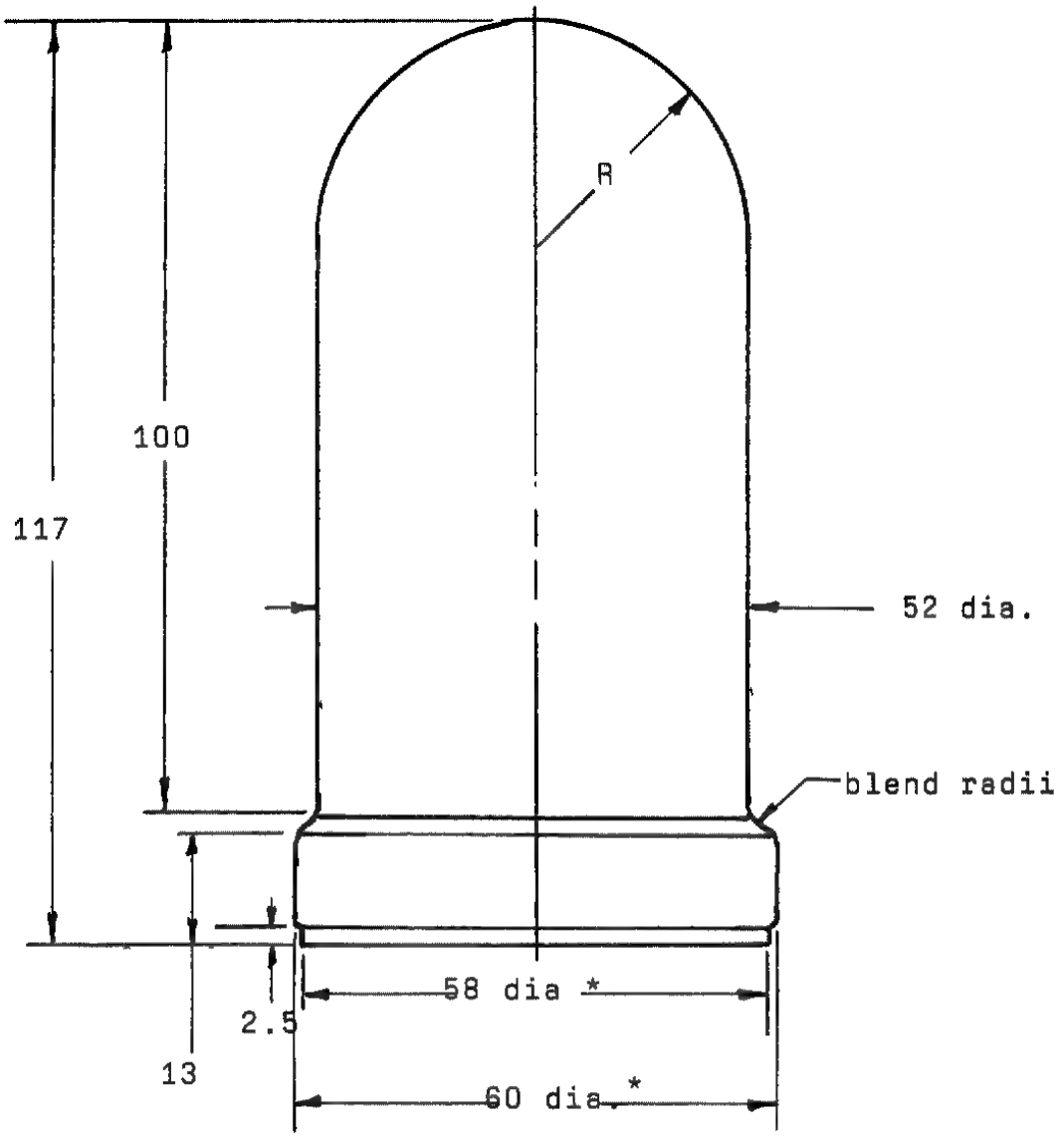
NOTES:

WARHEAD,METAL PARTS 450 g
FILLET 450 g

ALL DIMENSIONS IN MILLIMETERS

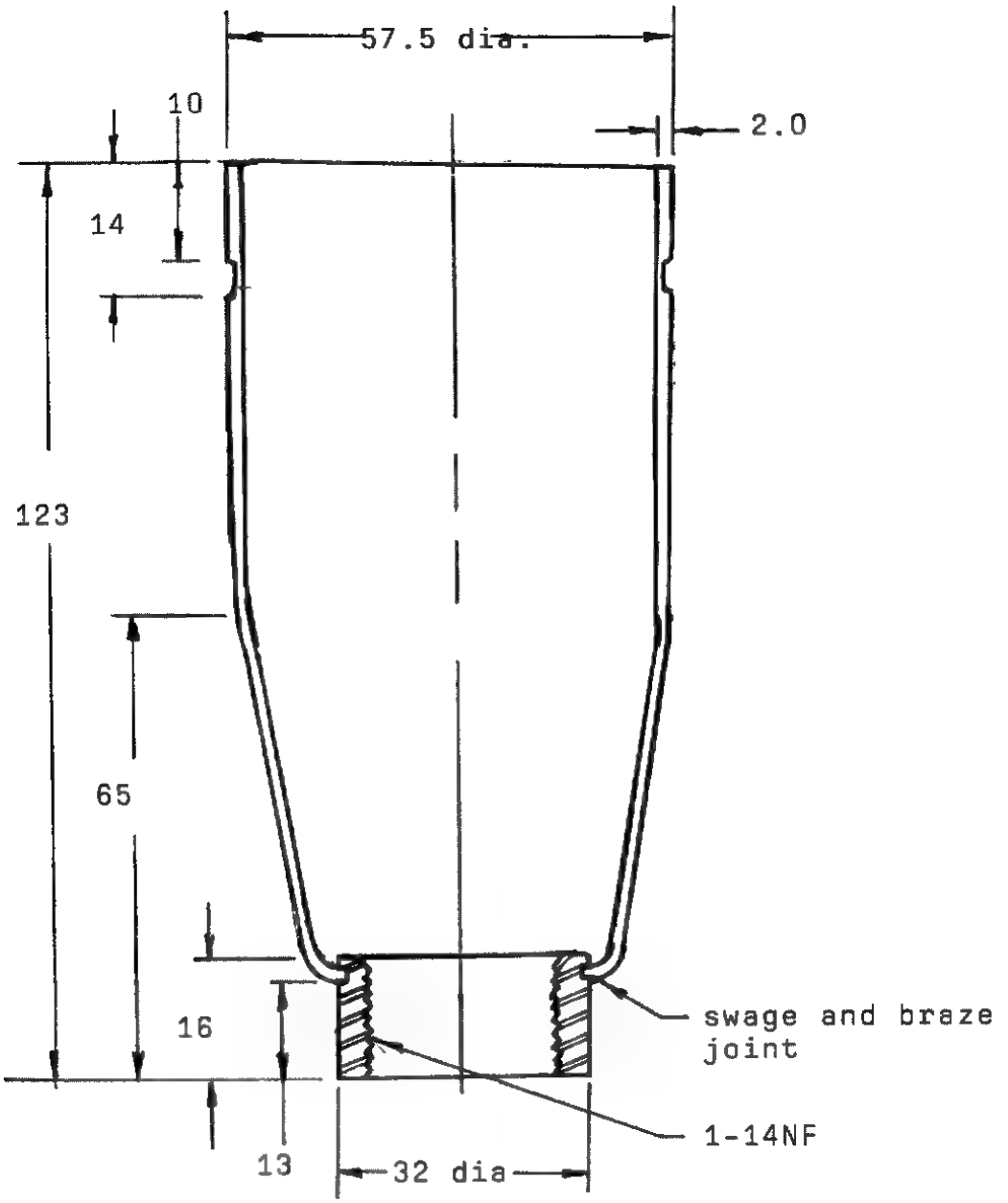


TYPICAL 2.36-inch HEAT ROCKET



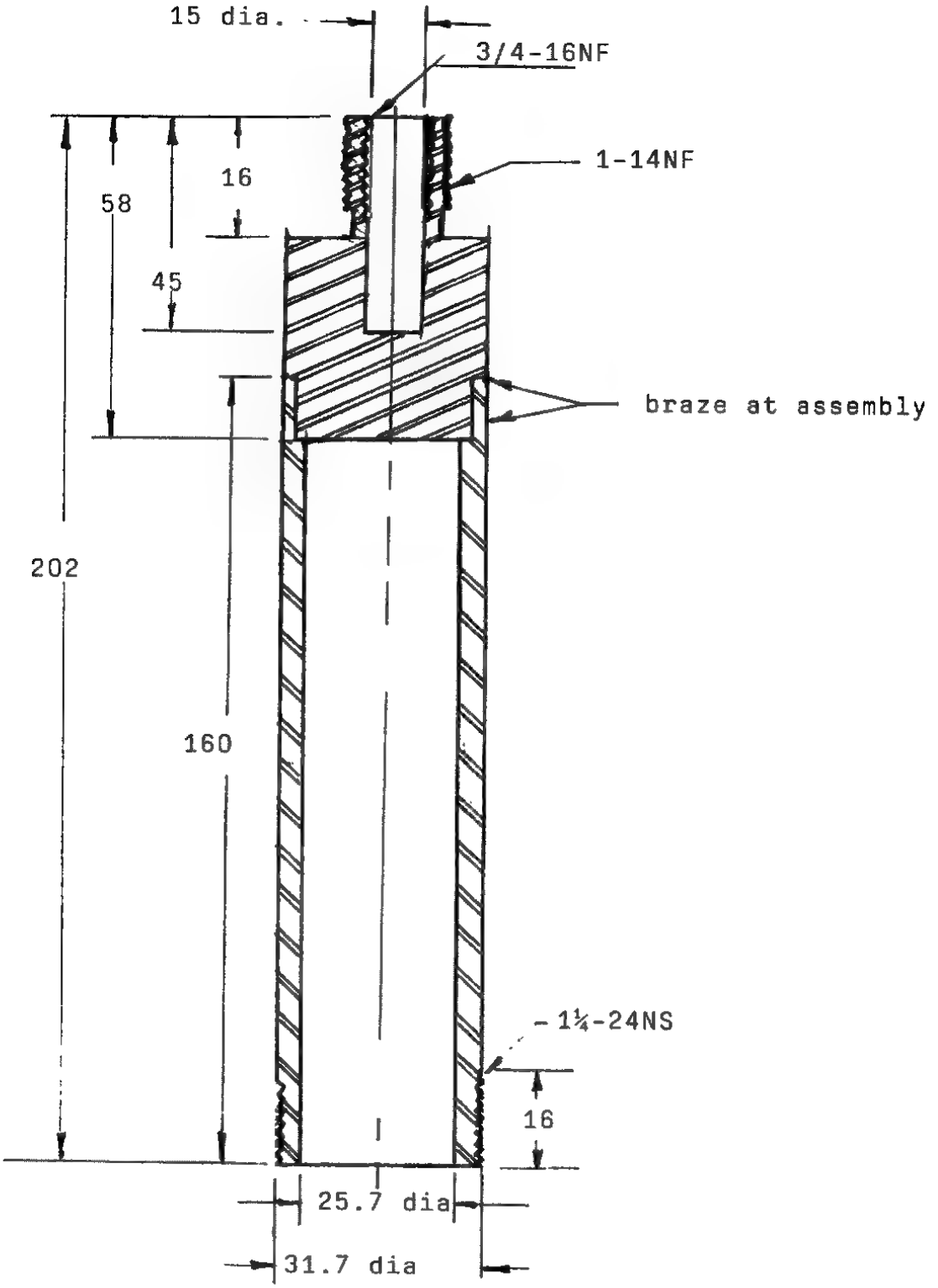
2.36 INCH HEAT ROCKET M6A3
STAND-OFF SHIELD
Material: 1.2 mm steel

Note: *) after crimping over warhead body
all dimensions are in millimeters



2.36 INCH HEAT ROCKET M6A3
WARHEAD BODY ASSEMBLY
Material: body - steel extrusion
union ; steel

Note: all dimensions are in millimeters

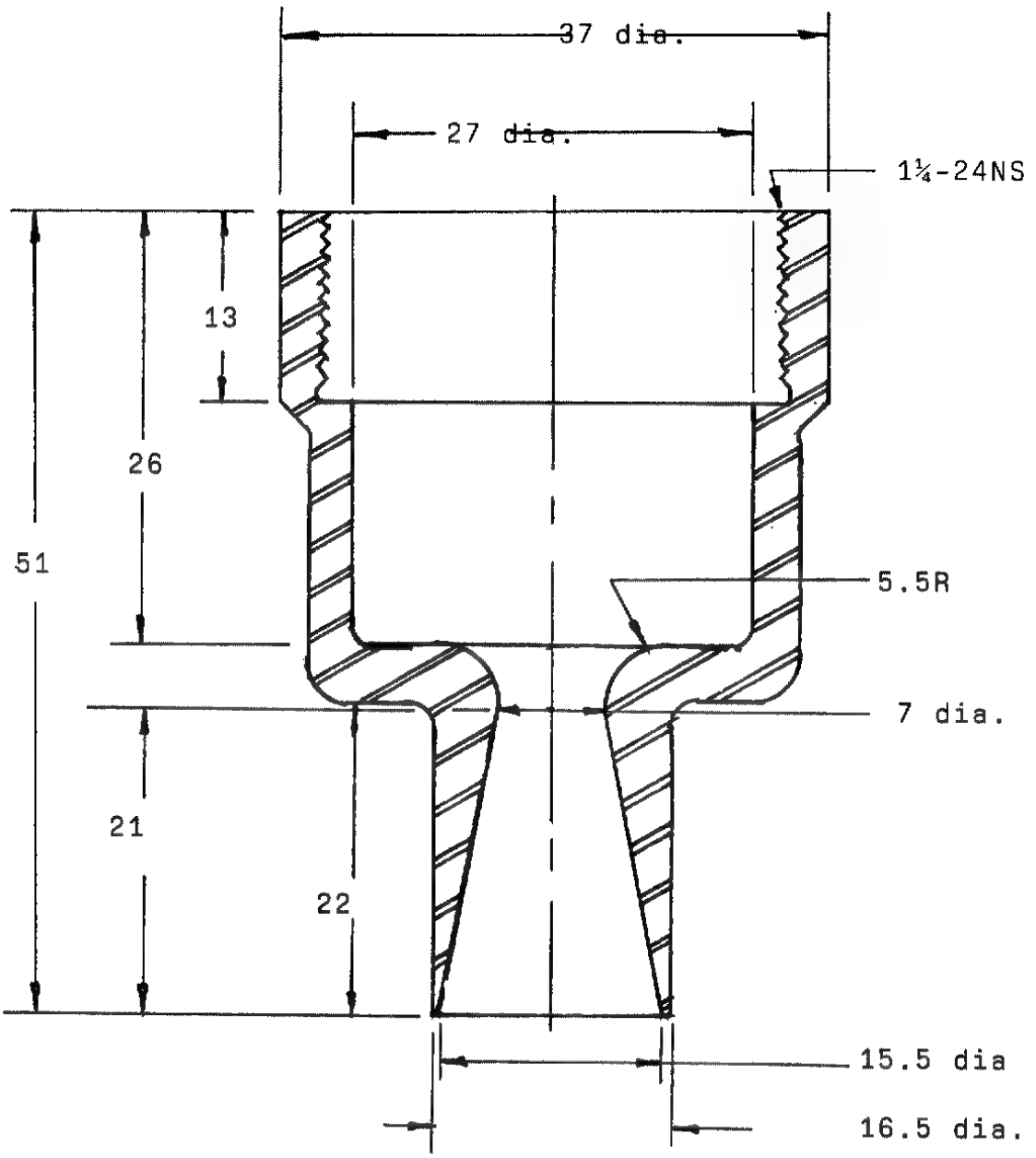


2.36 INCH ROCKET M6A3 MOTOR

Material: steel

weight : 500 ± 5 gram

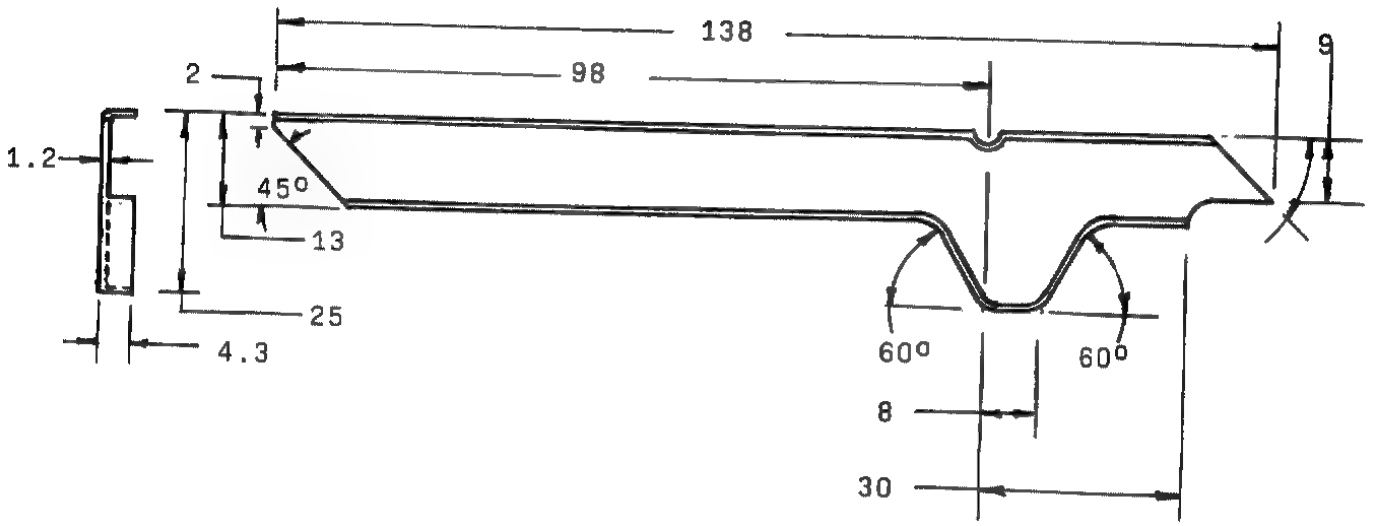
Note: all dimensions are in millimeters



2.36 INCH ROCKET M6 MOTOR NOZZLE

Material: steel extrusion

Note: all dimensions are in millimeters



2.36 INCH ROCKET M6

FIN

Material: steel extrusion

Note: 6 fins for each nozzle
all dimensions in millimeters

Some of the most obvious differences noted in the 60 MM rocket:

1 - Detonator is held in place by a flanged head, instead of threaded head.

2 - Motor front component threads into the warhead union instead of over it.

3 - Nozzle and fin assembly uses steel fins without ring vs. aluminum fins and retaining ring.

4 - The propellant charge varies, depending on the rocket total weight, to give the same external ballistics just like small arms ammunition.

M28A2 Rocket

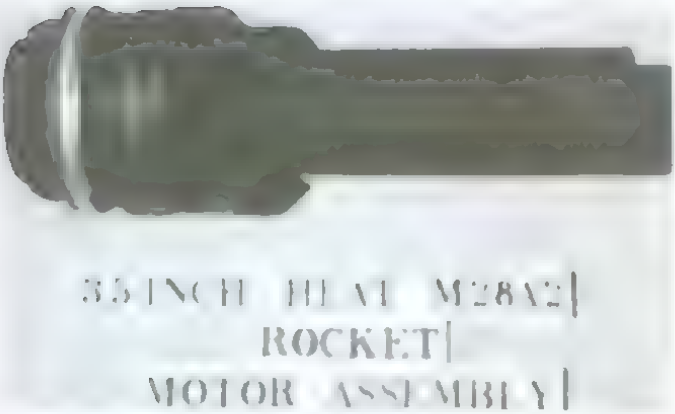
The M28A2 projectile is a larger size, more powerful and generally improved round based on the experience gained with the original M6 projectile. The following drawings give the basic data on the M28A2. As can be seen from these drawings there were two types of motor head closures. One type used the female thread OVER the motor body, while another type used male thread INSIDE the motor body. Apparently the "over-the-body" type was used initially since it gives a more positive closure under pressure. Later the "inside-body-thread" was found adequate under pressure, yet giving better aerodynamical form. The M28 series rocket motor contains the same BBP M-7 propellant but the charge has been increased to 12 individual non-perforated grains of 9 $^{1}/_{2}$ millimeter diameter by 125 millimeters long. Each grain weight is 13.2 grams giving a total weight of 160 grams.

The rocket motor igniter M20A1 is located at the FORWARD end of the motor. The electric lead wires from the squib are run along the bundle of the propellant grains and out through the nozzle. They are then connected to the respective ground and live cables and terminals.

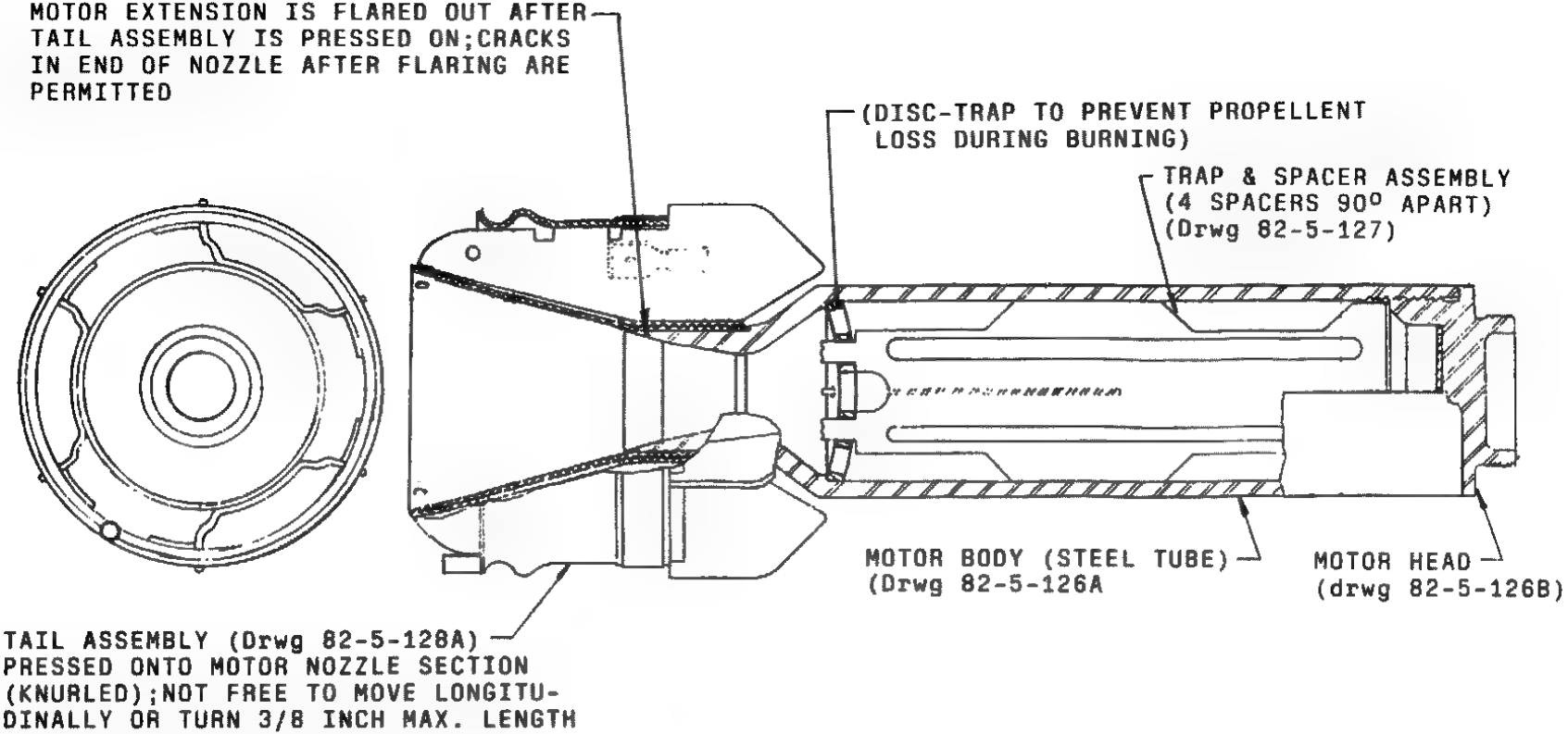
Studying the open literature of various technical manuals and drawings, textbooks and other reference materials, one is presented with an abundance of conflicting data. Measurements of actual samples further compound this confusion. The apparent discrepancies originate from the comparisons of different models, at different times and from different manufacturers. The following table gives good approximations to follow when building a re-enactment unit:

COMPONENT	ROCKET 60 MM	89 MM
	Grams	Grams
Warhead, HEAT -metallic parts	450	1020
HE filler	450	850
Safety (pin or strap)	20	30
Fuze assembly	150	450
Motor - metallic parts	730	1200
propellant	180	160
igniter	20	20
Total projectile weight, grams	2000	3730

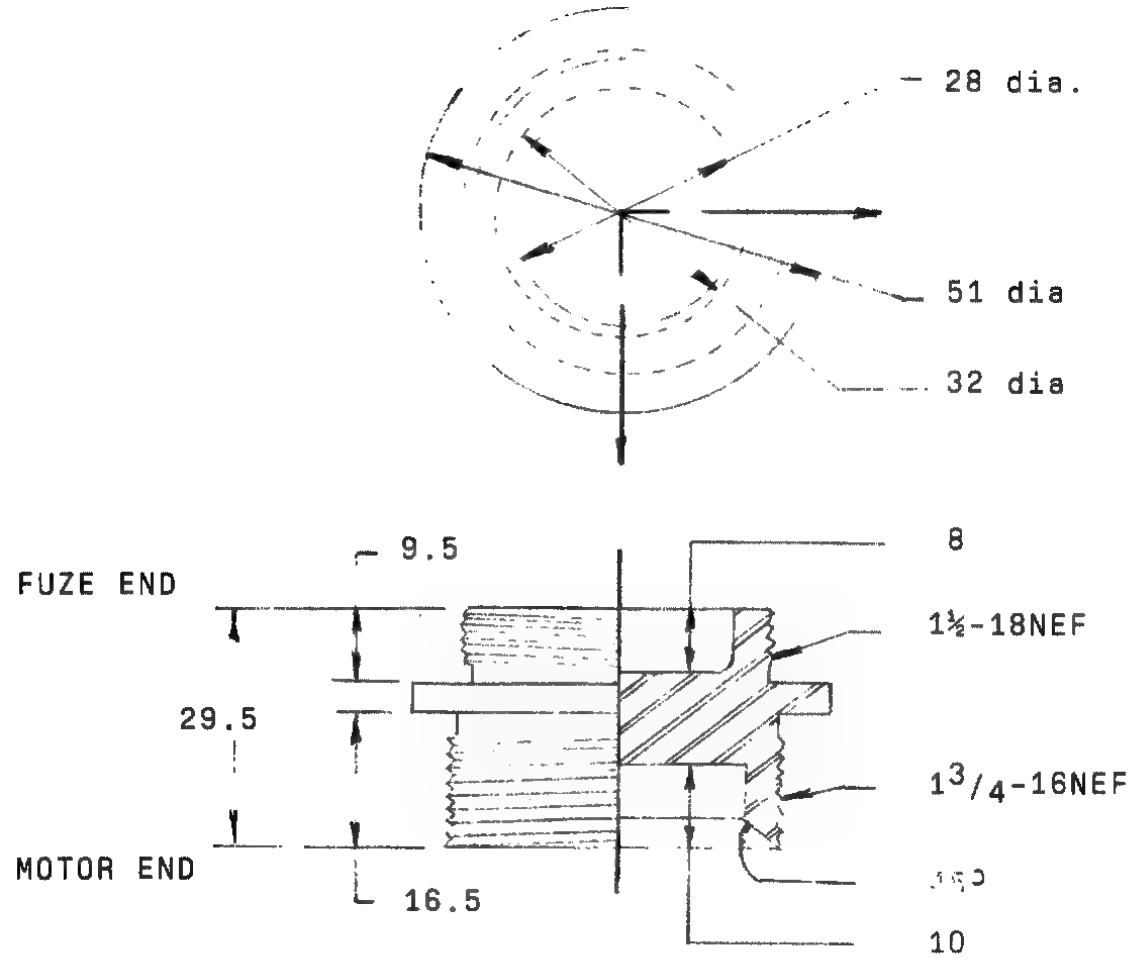
3.5 Inch HEAT M28A2 Rocket Warhead



3.5 Inch HEAT M28A2 Rocket Motor Assembly

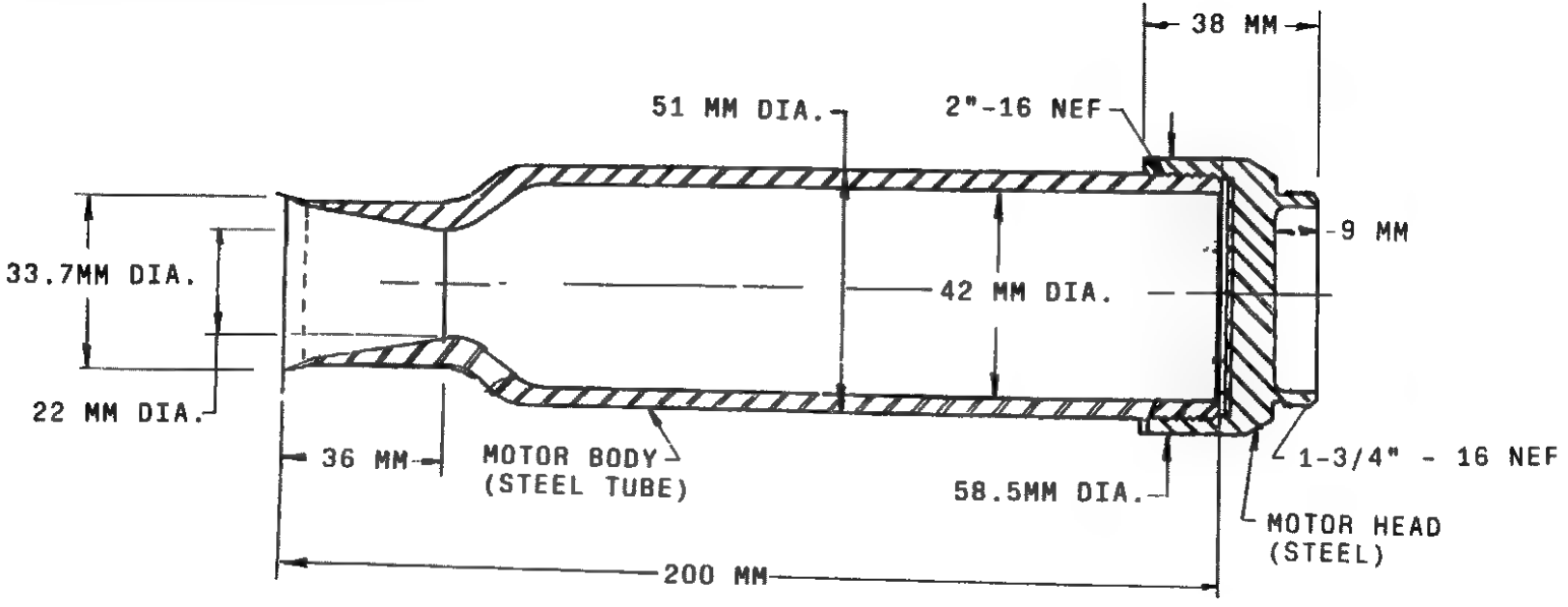


ROCKET,HEAT,3.5-INCH,M28A2,
MOTOR METAL PARTS ASSEMBLY
(Drwg 82-5-125A9)

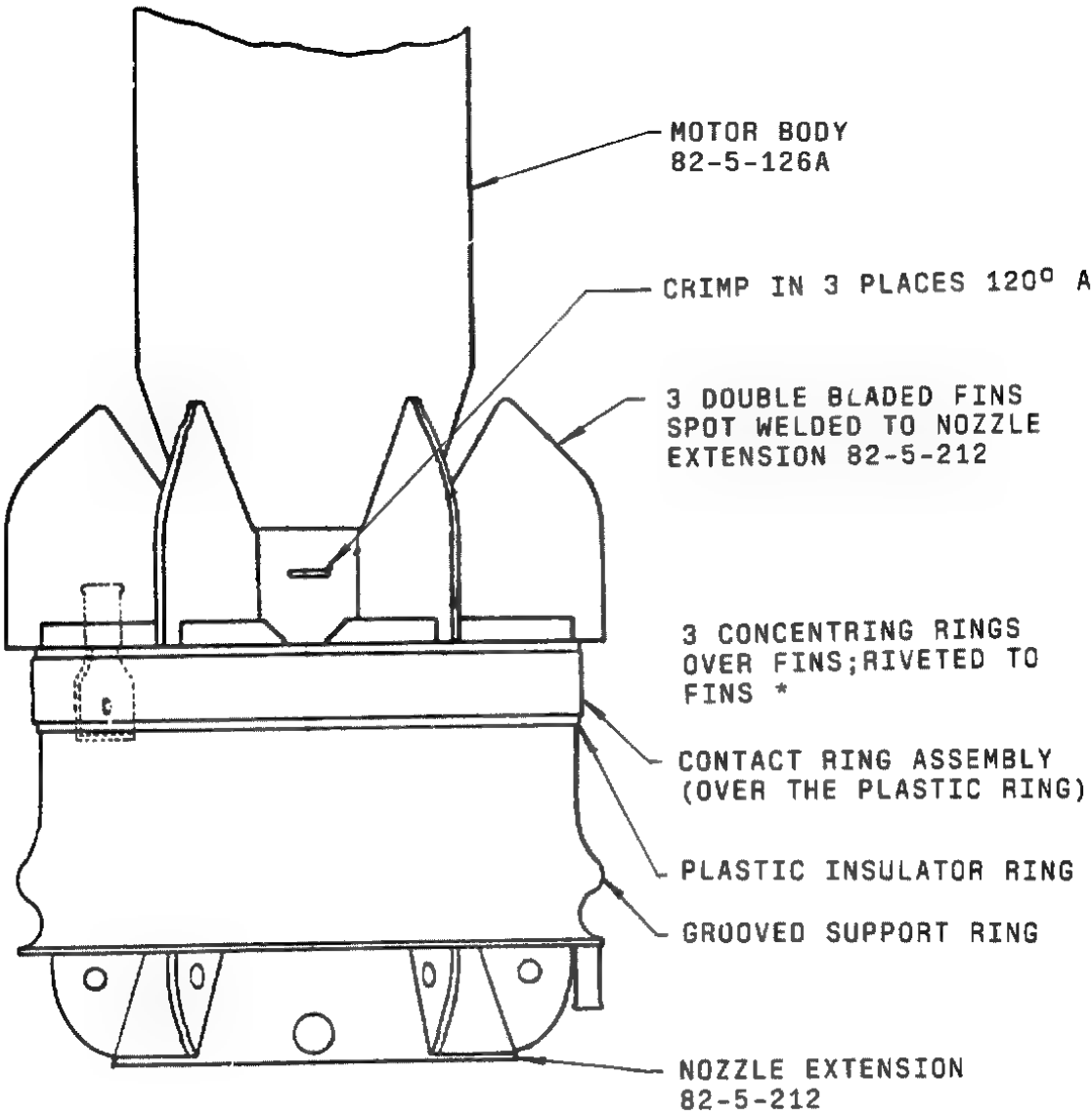


MOTOR HEAD
Drwg. 82-5-126B
Material: steel
Weight : 208 gram

NOTE: THE ORIGINAL ROCKET PARTS USED NON-STANDARD THREADS BUT THE REENACTMENT COMPONENTS CAN USE THREADS AND DIMENSIONS LISTED WITH NO LOSS OF PERFORMANCE.



ROCKET,HEAT, 3.5-INCH
MOTOR HEAD & BODY

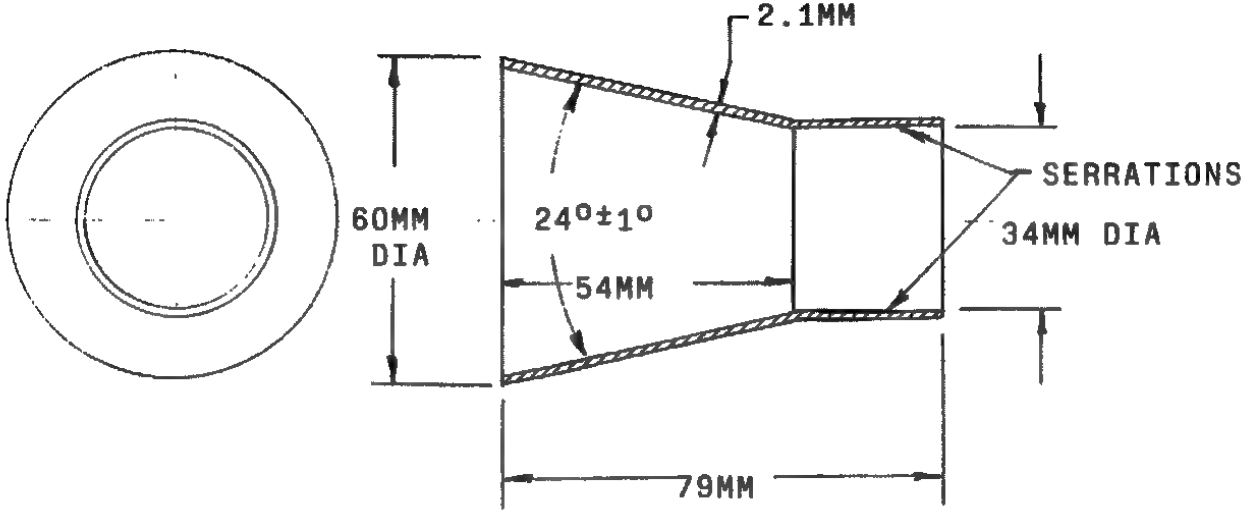


ROCKET,HEAT,3.5-INCH,M28A2 TAIL ASSEMBLY
(detail Drwg. F82-05-01)

NOTE: DETAILS OF THE INDIVIDUAL COMPONENTS ARE SHOWN ON SEPARATE DRAWINGS

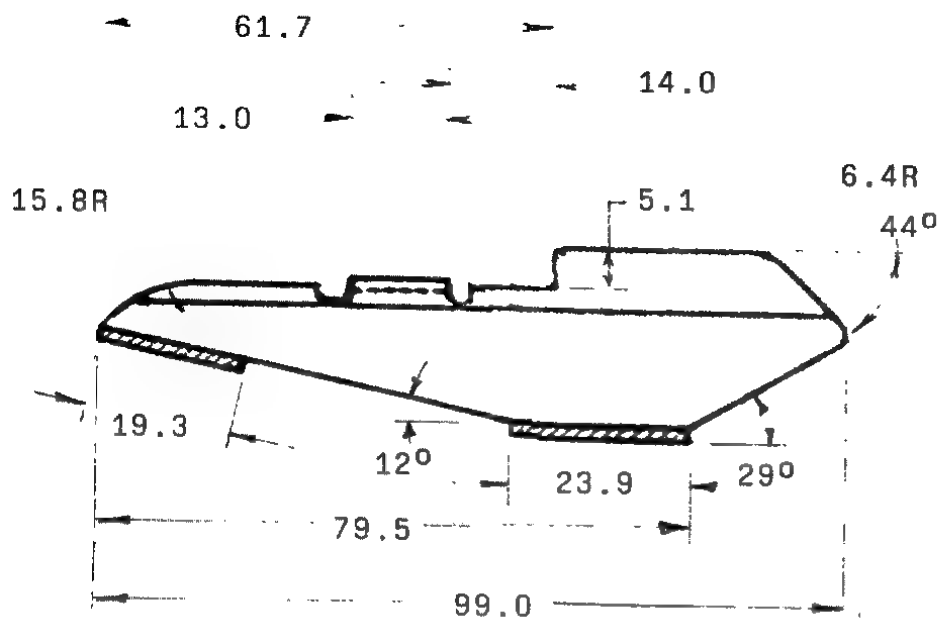
*) THE RIVETS ALSO SERVE TO CONNECT THE LEAD WIRES TO THE SUPPORT AND CONTACT RINGS

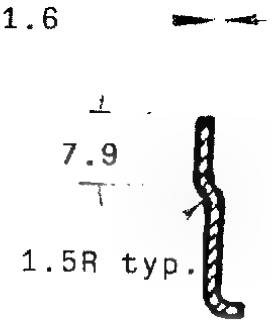
WEIGHT OF METAL PARTS ONLY OF MOTOR BODY (WITHOUT HEAD) AND THE FIN ASSEMBLY IS 1000 GRAM

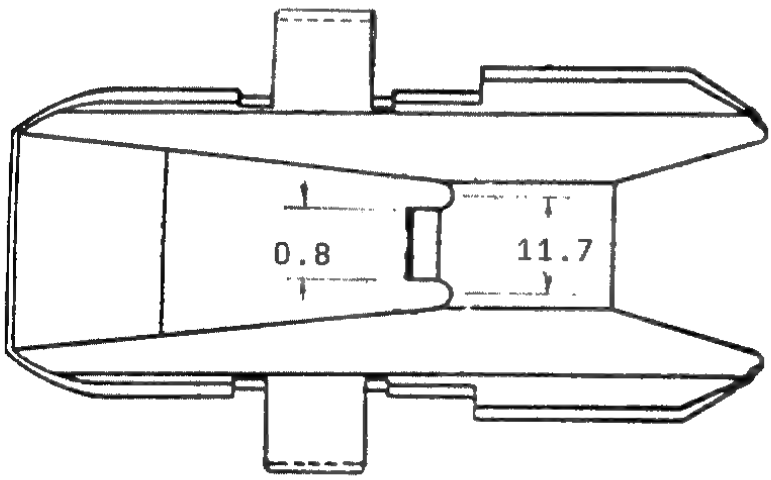


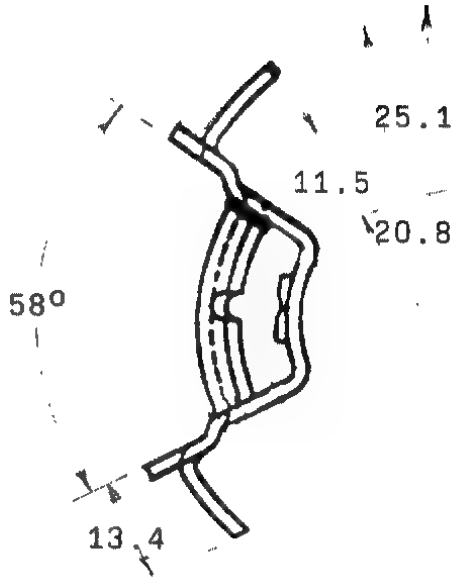
NOZZLE EXTENSION 82-5-212 FOR ROCKET,HEAT,3.5-INCH,M28A2

MATERIAL: ALUMINUM ALLOY









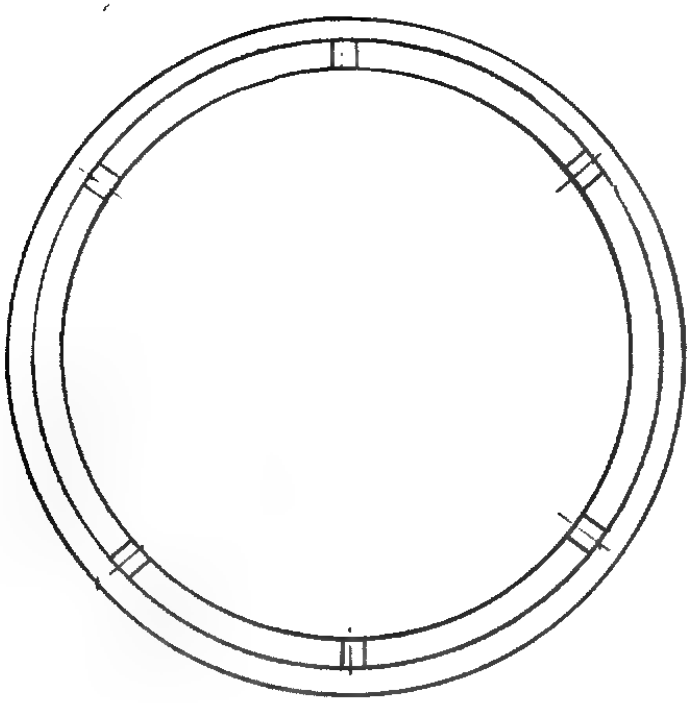
ROCKET,HEAT,3.5-INCH,M28A2

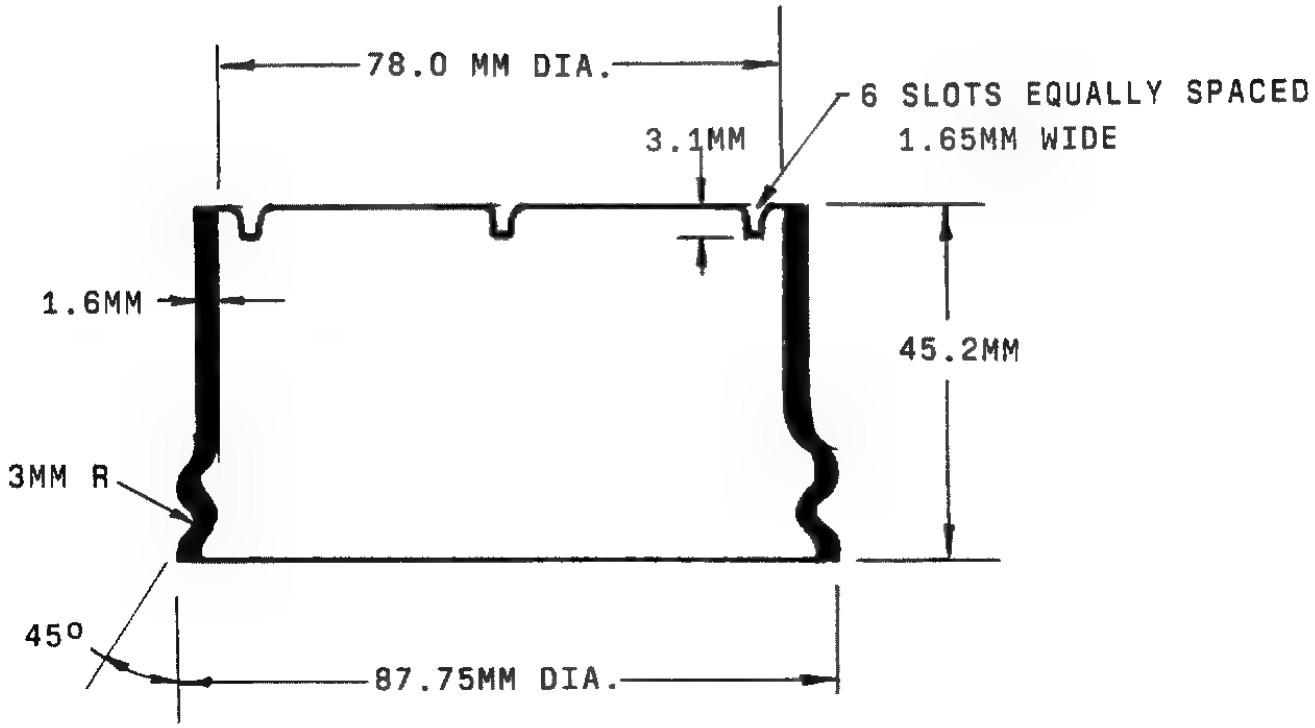
DOUBLE BLADED FIN 82-5-212A

MATERIAL: ALUMINUM SHEET
1.65 MM THICK
TEMPERED

REQUIRED: 3

NOTE: ALL DIMENSIONS ARE IN MILLIMETERS

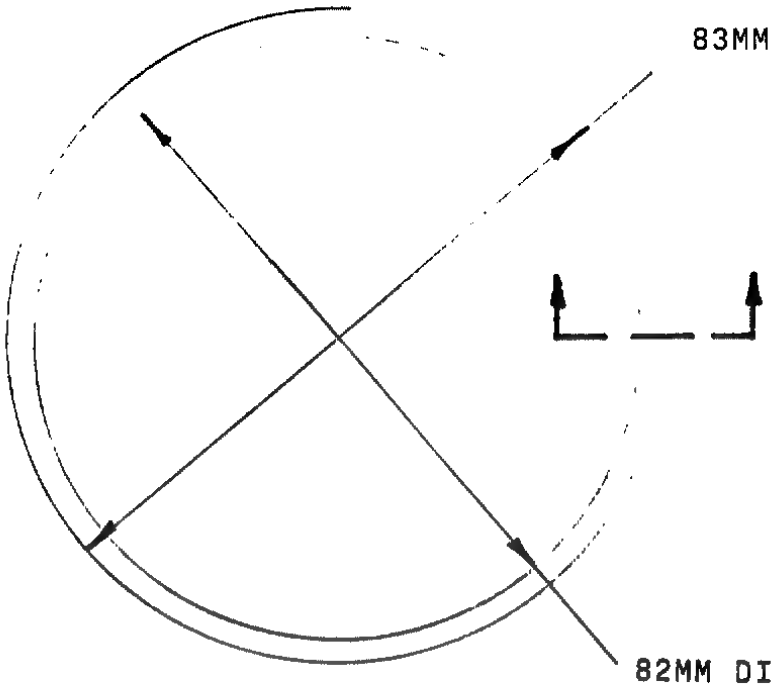




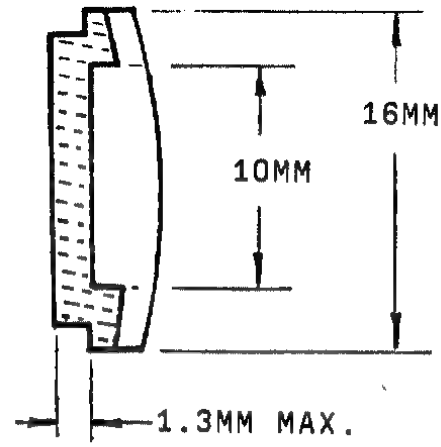
ROCKET,HEAT,3.5-INCH,M28A2

RING,SUPPORT 82-5-212

MATERIAL: ALUMINUM SHEET,TEMPER O



83MM DIA. ADJUST SO CONTACT RING WILL NOT TOUCH FINS ON TAIL ASSEMBLY

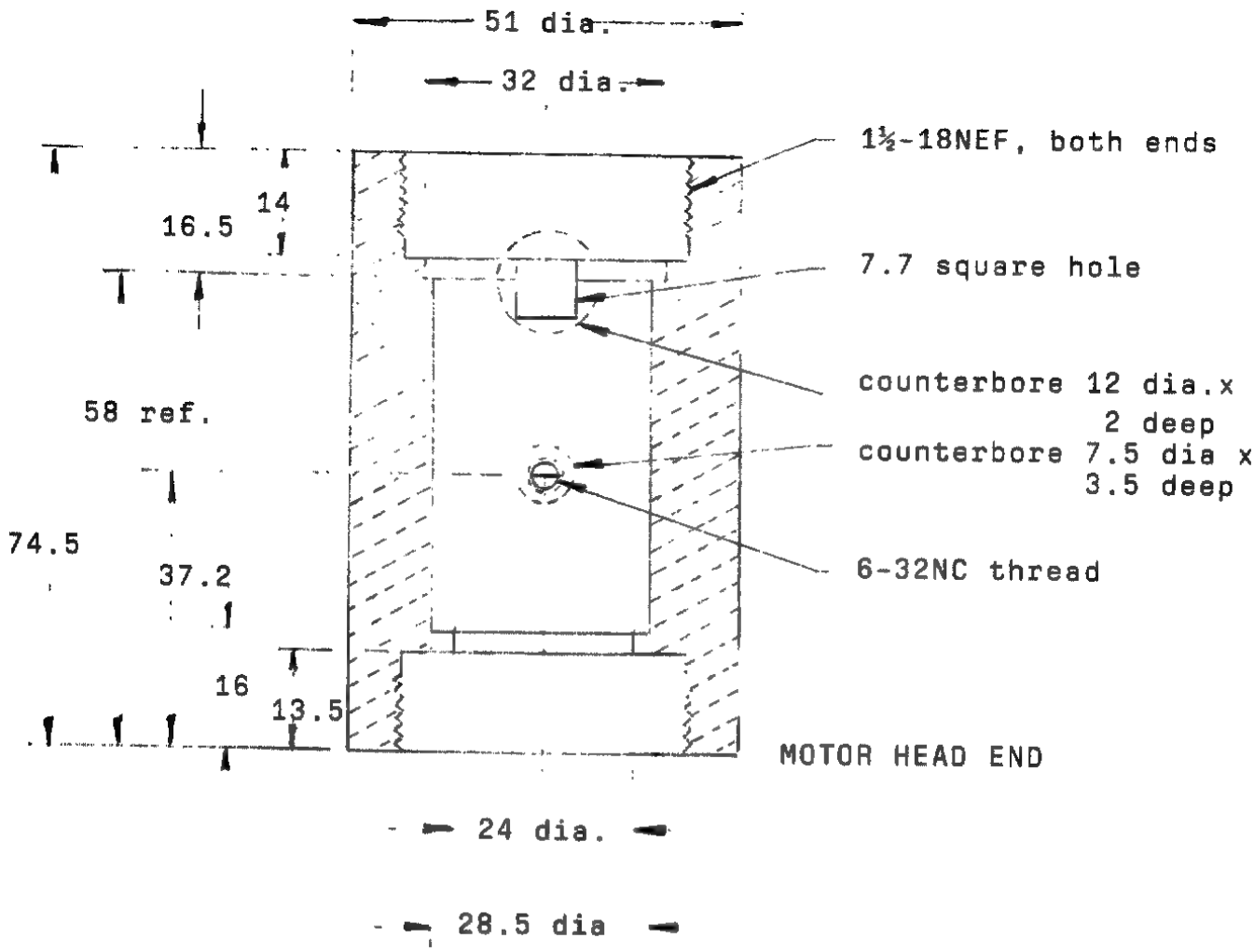


82MM DIA. ADJUST TO PROVIDE TIGHT FIT ON SUPPORT RING

ROCKET,HEAT,3.5-INCH,M28A2
RING,INSULATOR,
MATERIAL: MOLDED PLASTIC

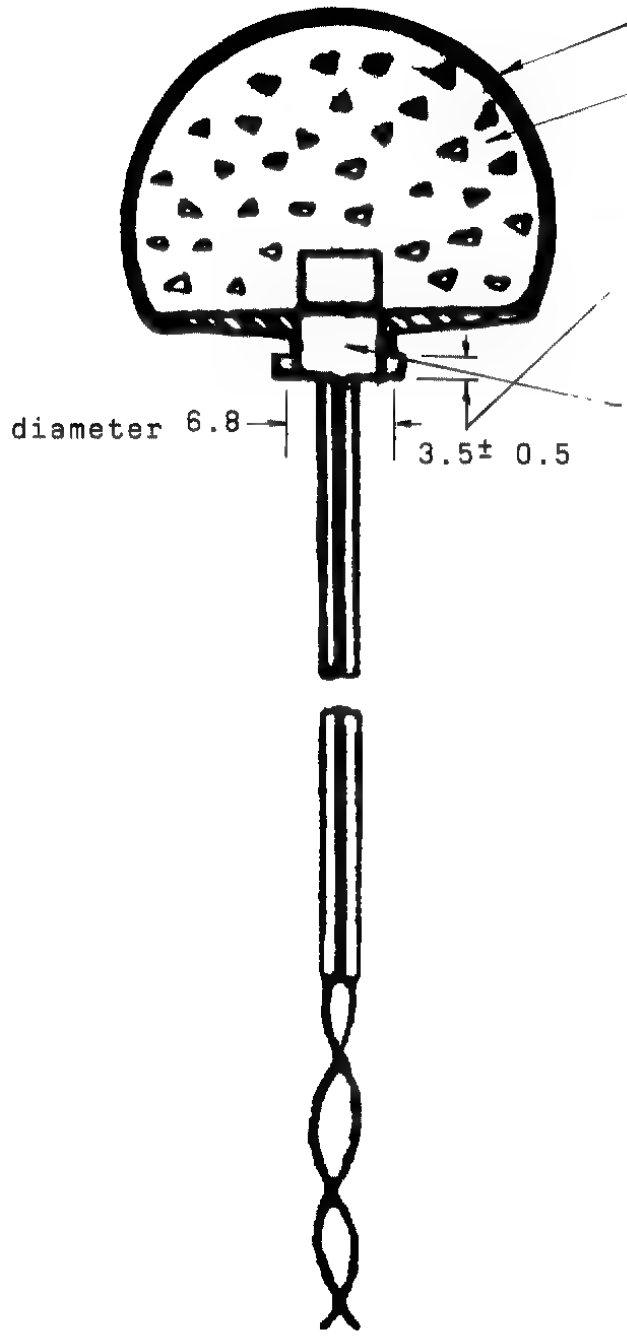
3.5 INCH HEAT M28A2
ROCKET FUZE
BD M404A2

3.5 INCH HEAT M28A2
ROCKET FUZE
BD M404A2



FUZE,ROCKET,BD, M404A2
BODY
Material: Aluminum
Note: all dimensions are in millimeters

IGNITER,ROCKET MOTOR,M20A1 (part 8886428)
FOR 3.5-inch ROCKET



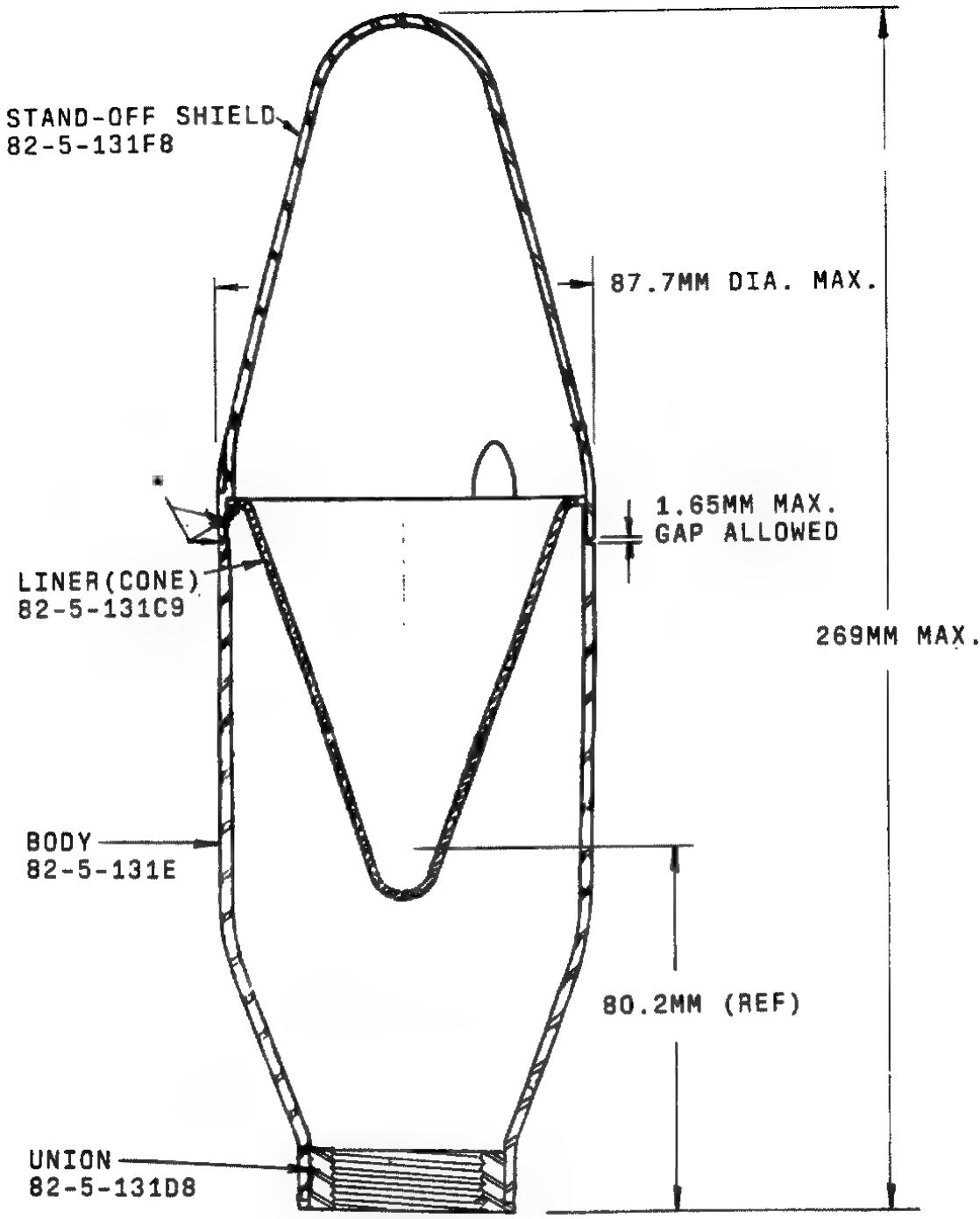
a-insert squib flush ± millimeters

b- heat seal at 230°C max. for 15 sec. max.

c-flash from heat seal not to extend beyond outside diameter of bottle neck

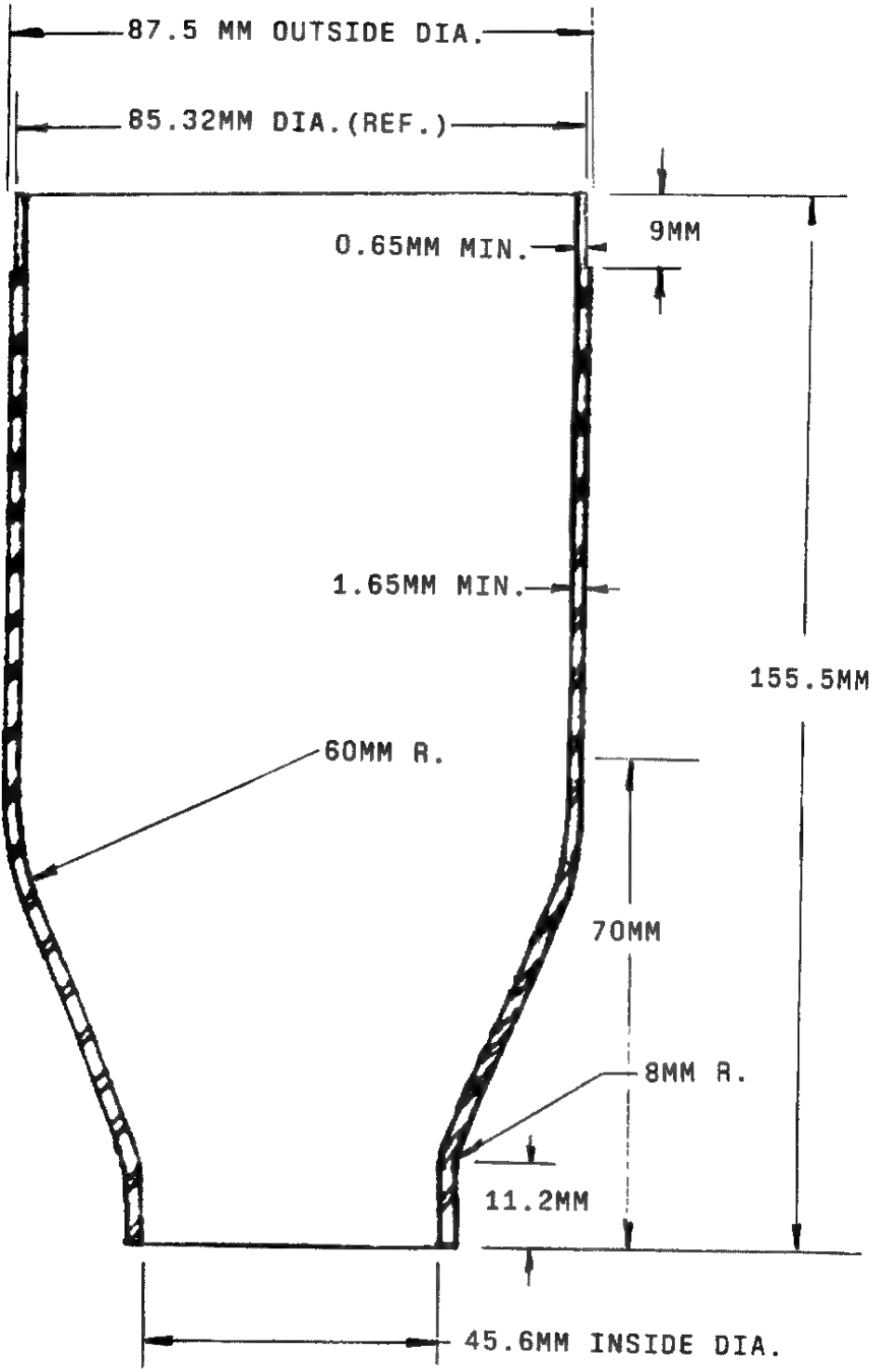
d-finished heat seal surface must withstand a force of 2 Kg min.at 21°C for 10 seconds pulling the lead wires along the squib axis

Note: all dimensions are in millimeters

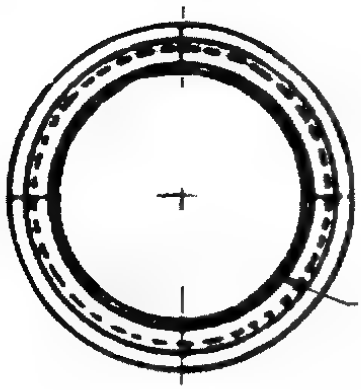


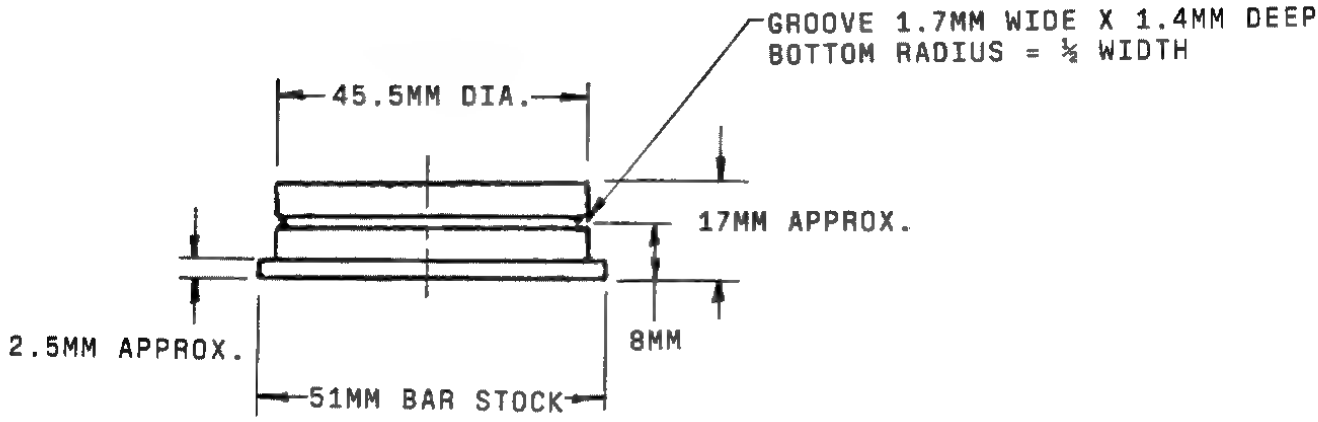
ROCKET,HEAT,3.5-INCH,M28A2
HEAD METAL PARTS ASSEMBLY (Drwg.82-5-131A9)
WEIGHT: 1187 ± 36 GRAM (METAL COMPONENTS ONLY)

* BRAZE 360° WITH BRAZING ALLOY,SILVER-BASE, (1.6MM DIA. WIRE X 300MM LONG APPROX.)WITH BRAZING FLUX.REMOVE EXCESS SLODER BY MACHINING AFTER ASSEMBLY.



ROCKET,HEAT,3.5-INCH,M28A2
BODY,HEAD (Drwg.82-5-131E)
MATERIAL: STEEL TUBING,HOT ROLLED,SEAMLESS,MECHANICAL
FINISH: 125√ ALL OVER





ROCKET,HEAT,3.5-INCH,M28A2
UNION (Drwg.82-5-131D8)

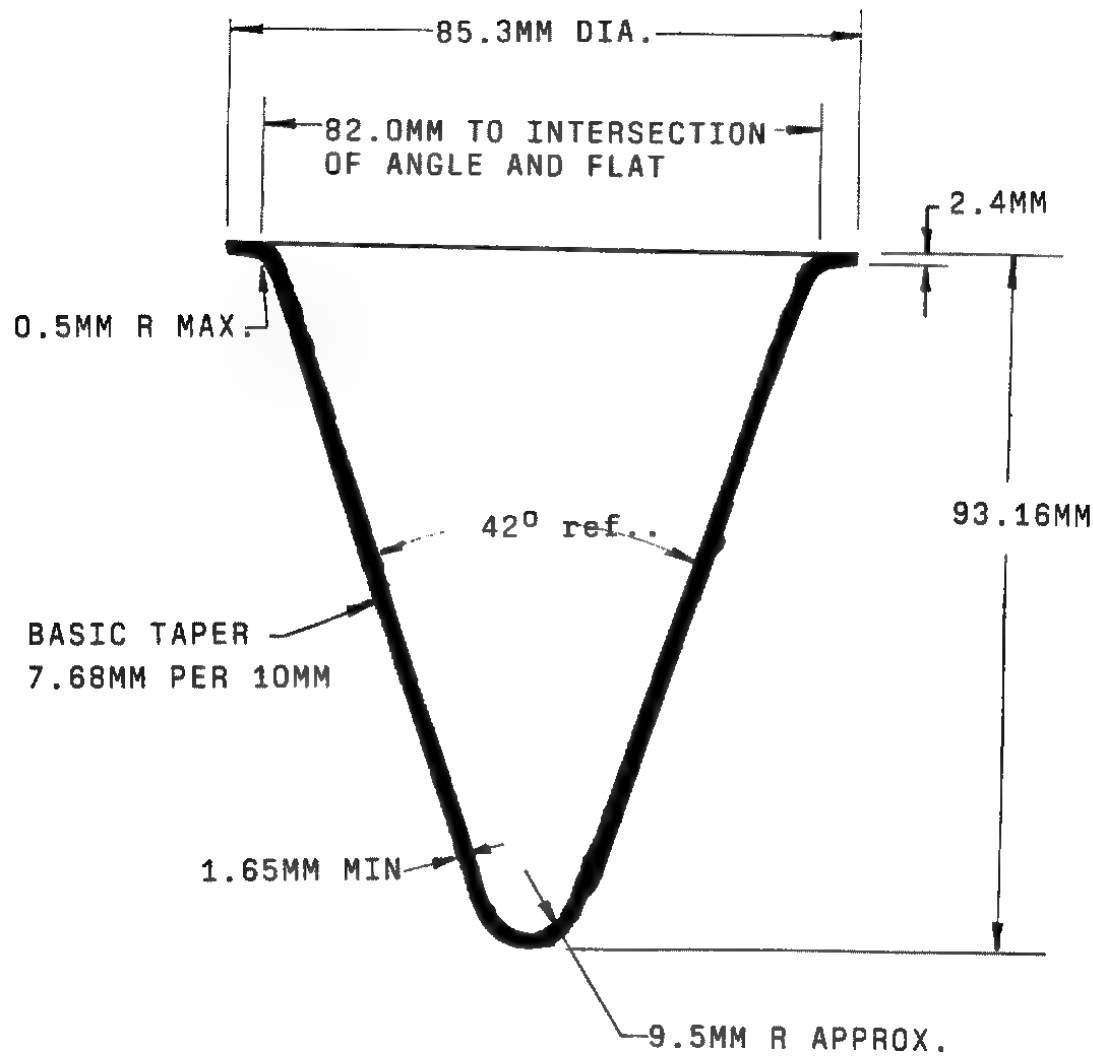
MATERIAL: STEEL,BAR,FS1117,COLD ROLLED

FINISH: 125/ALL OVER

NOTES: a - UNION IS FITTED AND BRAZED INTO BODY,HEAD (Drwg.82-5-131E)

b - THE ASSEMBLED OVER ALL LENGTH IS 158MM

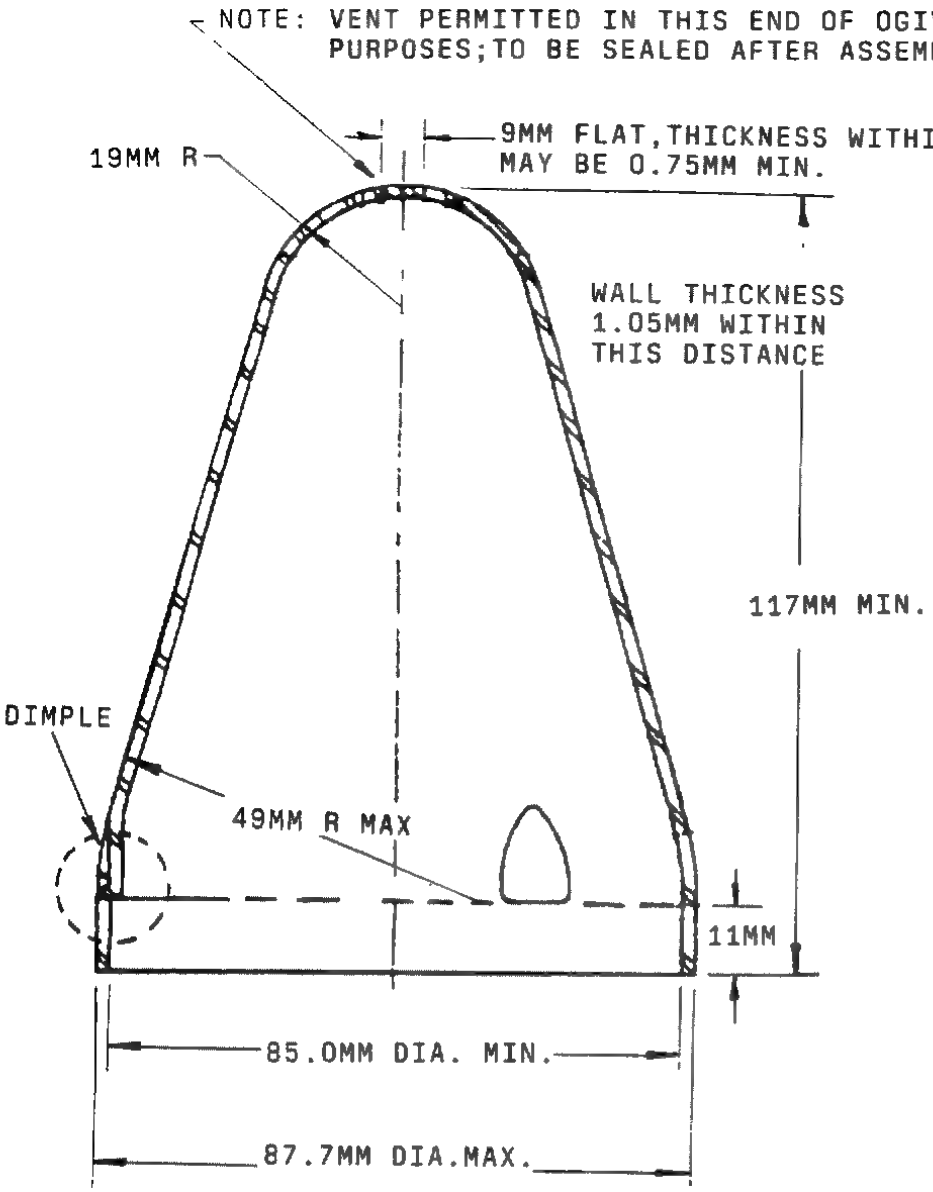
c - THE ORGINAL ROCKET M28A2 USED 1½-20NS (NON-STANDARD) THREAD BUT 1½-18NEF IS ADEQUATE

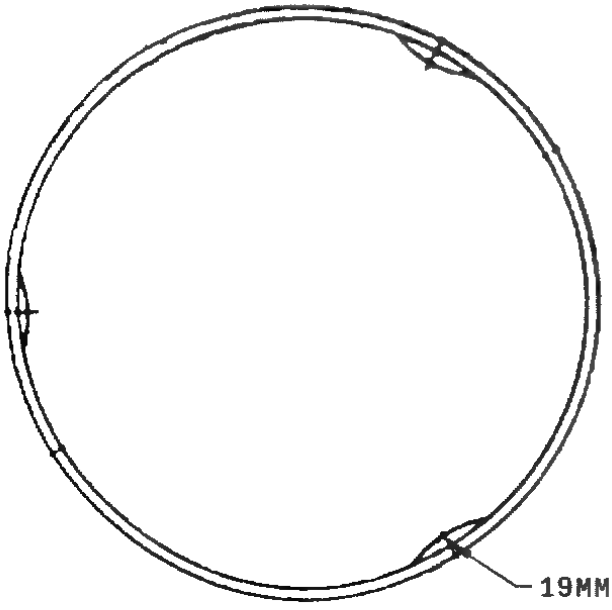


ROCKET,HEAT,3.5-INCH,M28A2
CONE,HEAD (Drwg.F82-5-131C9)

MATERIAL: COPPER,SHEET,COLD-ROLLED
DEEP DRAWING,ANNEALED

FINISH: 125√ ALL OVER



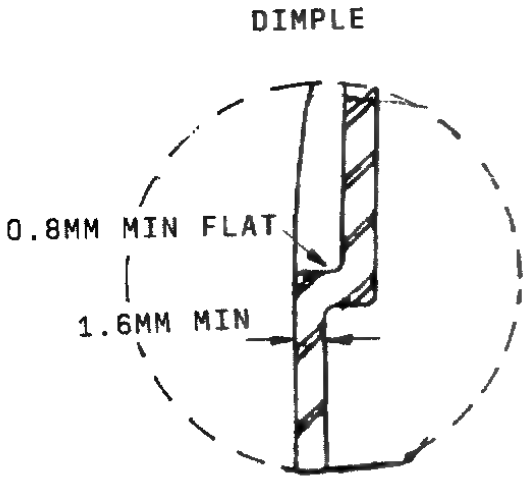


ROCKET,HEAT,3.5-INCH,M28A2
STAND-OFF SHIELD(OGIVE)
(Drwg.82-5-131F8)

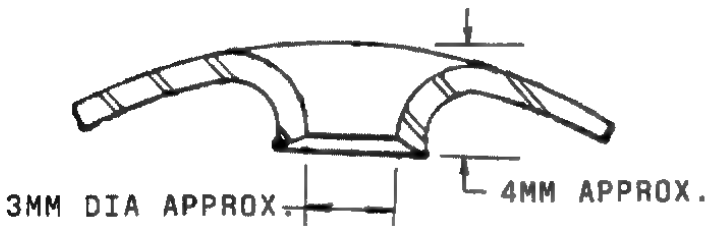
MATERIAL:STEEL STRIP FS1009
TEMPER #5,FINISH #1

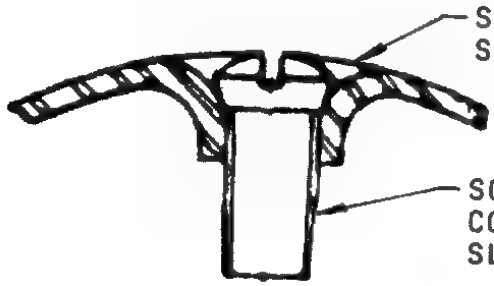
FINISH: 125√ ALL OVER

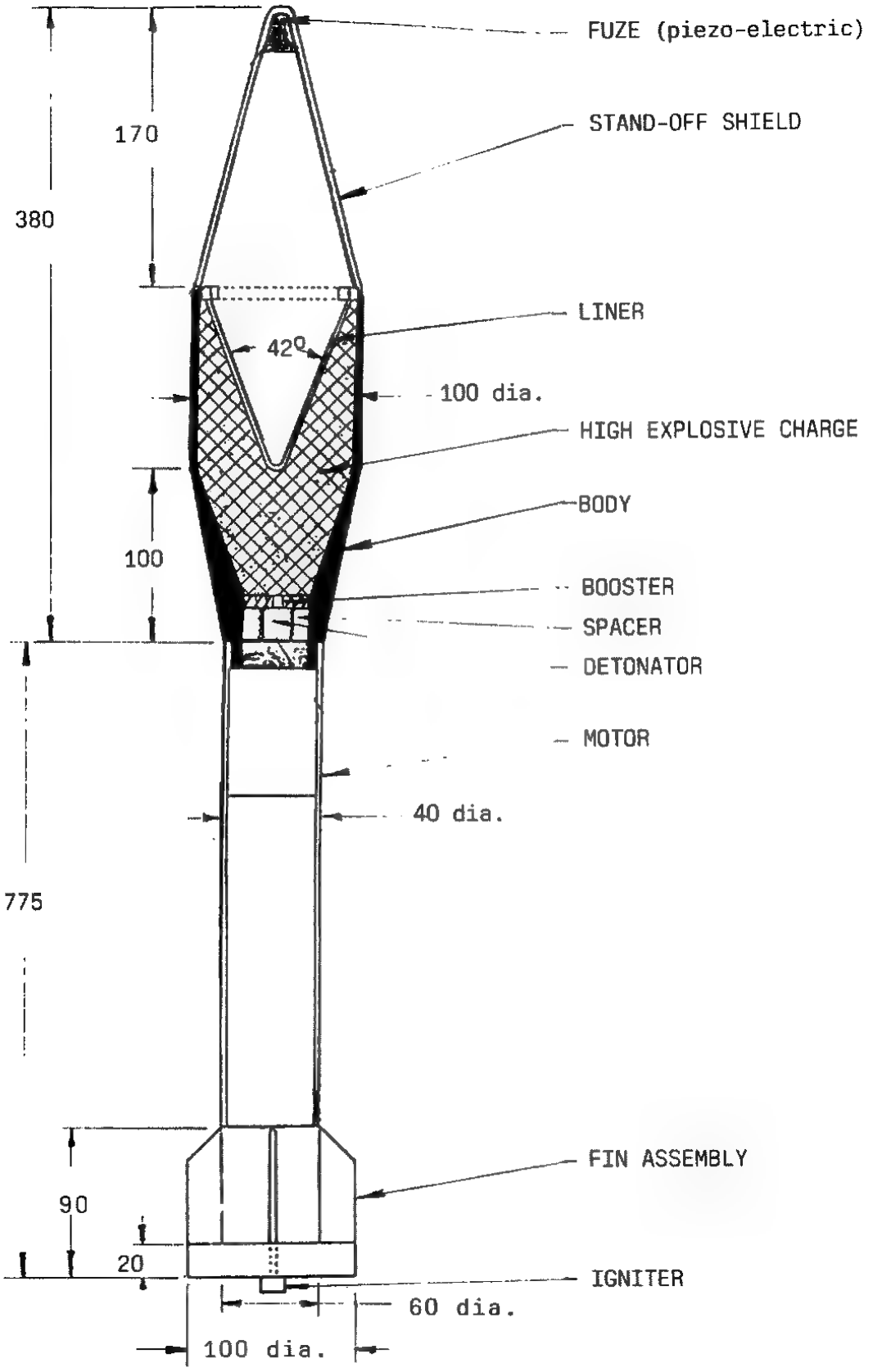
ROCKET,HEAT,3.5-INCH, M28A2
STAND-OFF SHIELD (OGIVE)
DETAILS



OPTIONAL OGIVE CLOSING DETAILS





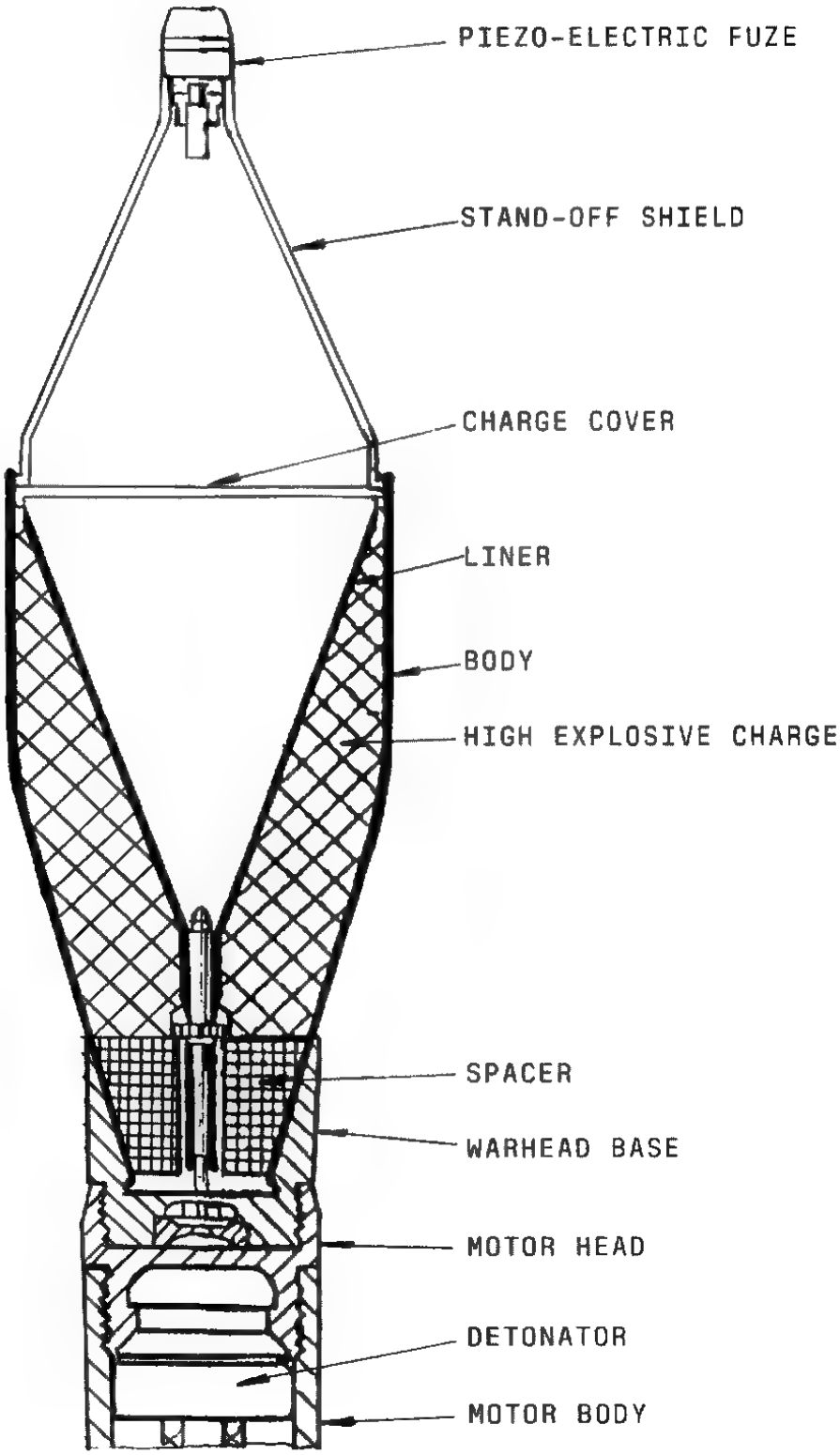


LAYOUT OF A 100MM HEAT ROCKET

all dimensions are in millimeters

TYPICAL 3.5- inch HEAT WARHEAD

(a European production variant)



Reenactment Bazooka Launcher

The problem with the reenactment bazooka lies in the differences between the diameters of the readily available launcher pipes (plastic) and the equally readily available warhead bodies (canned food containers).

A M-9 or M-18 launcher can be made from a 2 $^{1}/_{2}$ inch PVC schedule 40 pipe (although standard size, it is not always available on the plumbing supplier's shelves). The appropriate warhead body will require a resizing operation on a soup can body to give it a smooth sliding fit into such launcher. The dimensions of some typical metallic food containers are given at the end of the Panzerfaust chapter.

Another launcher material is a heavy cardboard tubing (textile roll supports, etc.) of appropriate length. Obviously, a thin wall seamless steel tube/cylinder makes the best launcher material. Regardless, whether plastic or cardboard, the launcher should be reinforced with a sleeve of seamless steel tube in the area adjacent to the user's body. Furthermore, the reenactment launcher should be wrapped with a fiberglass reinforced adhesive tape for added protection (prior to painting). The face shield, grip and shoulder support can be made from appropriate size steel, plastic (formica, etc.) and soldered, riveted and/or glued with epoxy to the reinforcing sleeve.

When building a reenactment launcher (M-9 or M-20) and putting together the corresponding projectiles and rocket motors it becomes apparent that the Panzerfaust is the preferred reenactment equipment, in spite of its shortcomings.

The reenactment bazooka rocket motor is the key component of the projectile. It can be made from a suitable diameter cold rolled steel pipe. The following description refers to the M-6A3 motor.

The motor body is a piece of 8 $^{1}/_{2}$ inch (215 mm) long 1 inch nominal steel pipe, having a 1 $^{1}/_{2}$ inch inside diameter and 1 $^{5}/_{16}$ inch outside diameter. The nozzle (see sketch) is welded into one end of the body. The other end is threaded 1 $^{1}/_{4}$-I2NF thread for 1 inch full thread. The fin assembly is placed over the nozzle end and secured by soldering, brazing, or epoxy adhesive.

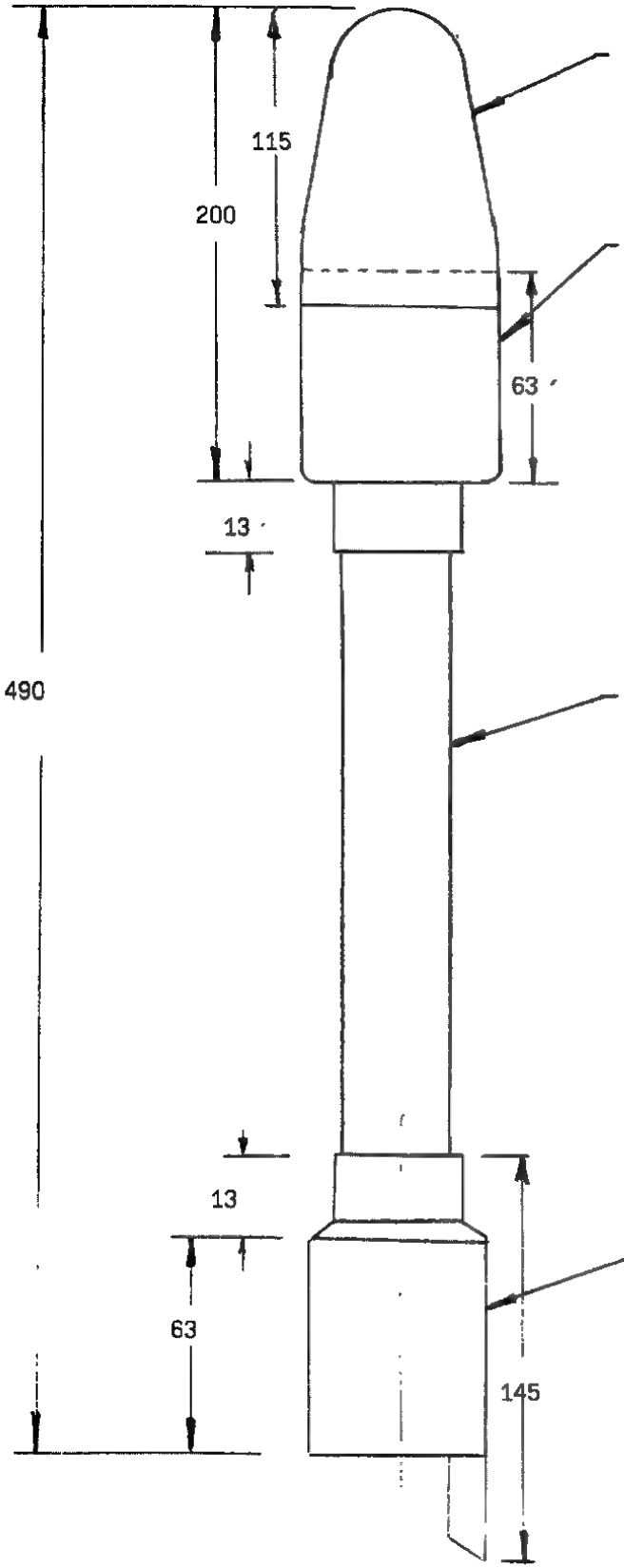
The motor subassembly is seated onto the tamping fixture (see sketch). The black powder propellant is loaded into the front end of the motor in small, uniform increments. Each increment is compacted by use of rammer and wooden (or rubber) mallet. After the addition and compacting of the last increment, the remaining space in the body is filled with paraffin wax and the motor head is screwed tightly onto the motor body. After removal of the charged motor from the tamping fixture a small quantity (about a half teaspoon) of loose powder is poured into the nozzle end of the motor and an electric igniter is seated into the nozzle throat. The igniter is secured in place by a bead of adhesive (a common type paper cement will work) and a spaghetti-like piece of warm paraffin wax which waterproofs the joint. The motor is now ready for assembly to the warhead. The M-28 rocket motor may be assembled in a similar fashion.

Some observations on the reenactment bazooka rocket motors:

A good, safe and reliable motor requires a substantial amount of machining. The preparation, testing and loading of the propellant also entails a lot of time and effort. Short cuts are dangerous and costly. Attention must be paid to details, choice of the best materials available and safety. The payoff is in the joy of observing the splash of orange warhead filler on the distant target.

When considering alternative materials and designs, bear in mind that the most important single consideration is the proper balance between the strength of the motor components and the forces (pressure) generated by the propellant. Unfortunately, strong and heavy components and a low pressure results in reduced range. Light motors and increased pressure leads to ruptured motors (and even launchers) with possible serious injury. The professional ordnance establishments can experiment. They have the facilities, personnel and monies.

RE-ENACTMENT 66MM ROCKET M6



STAND-OFF SHIELD
formed cardboard

WARHEAD BODY
evaporated milk cal,5 FL oz
65 mm OD (± 2½ inches)

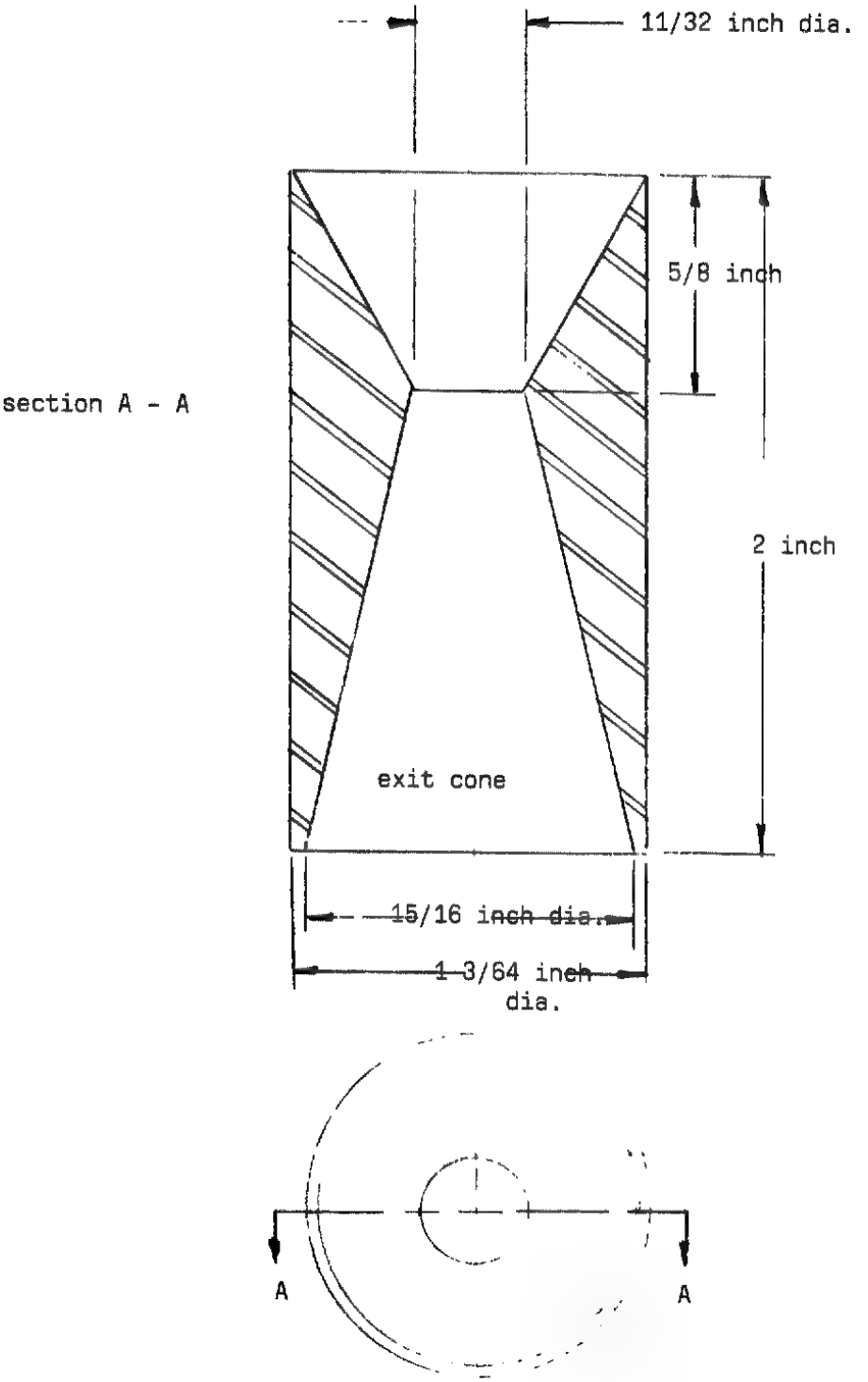
MOTOR
1 inch nominal size steel pipe

FIN ASSEMBLY
soldered or brazed construction
evaporated milk can (5FL oz) body
ring with sheet metal fins

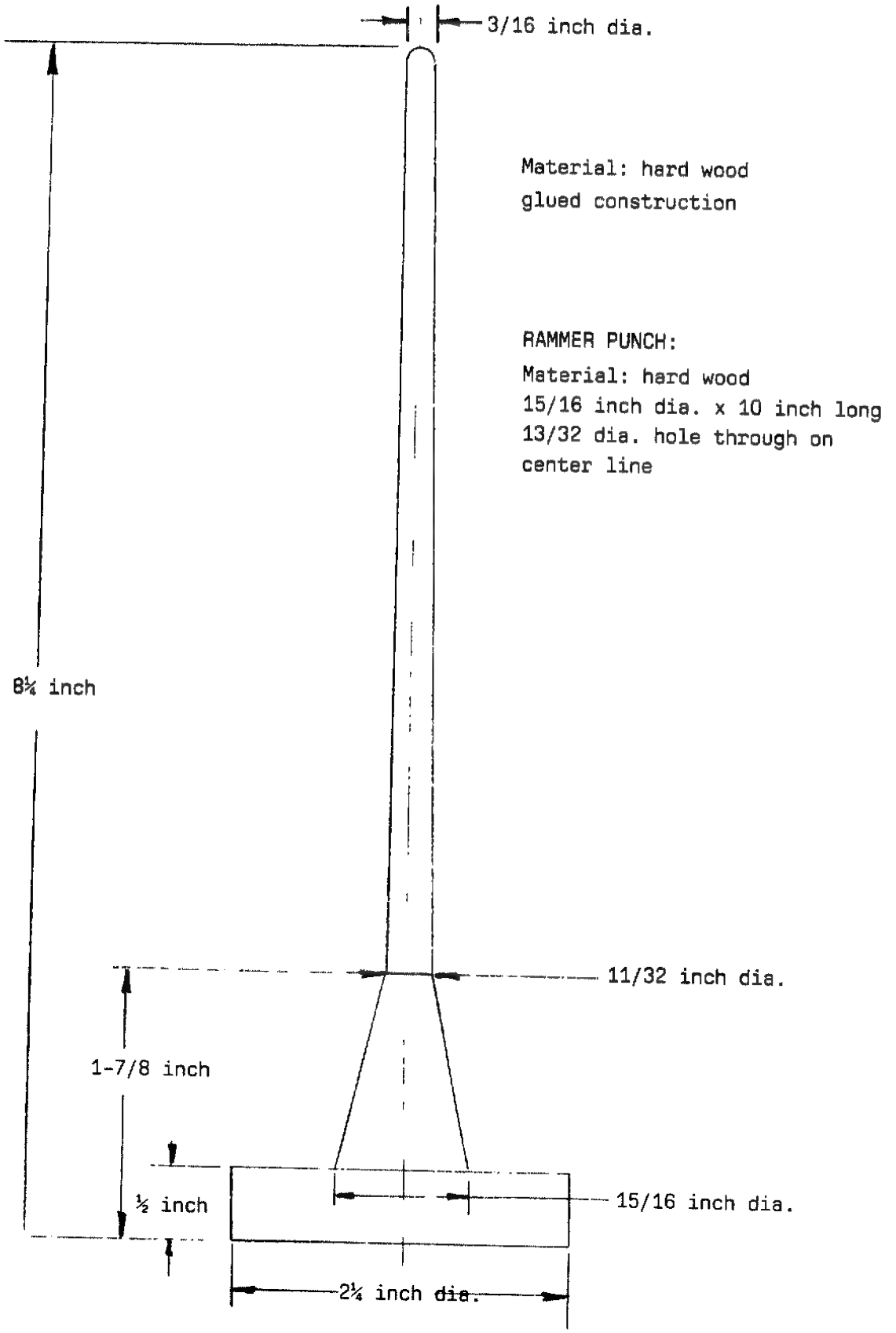
Note: all dimensions are in millimeters

RE-ENACTMENT BAZOOKA MOTOR NOZZLE

Material: steel

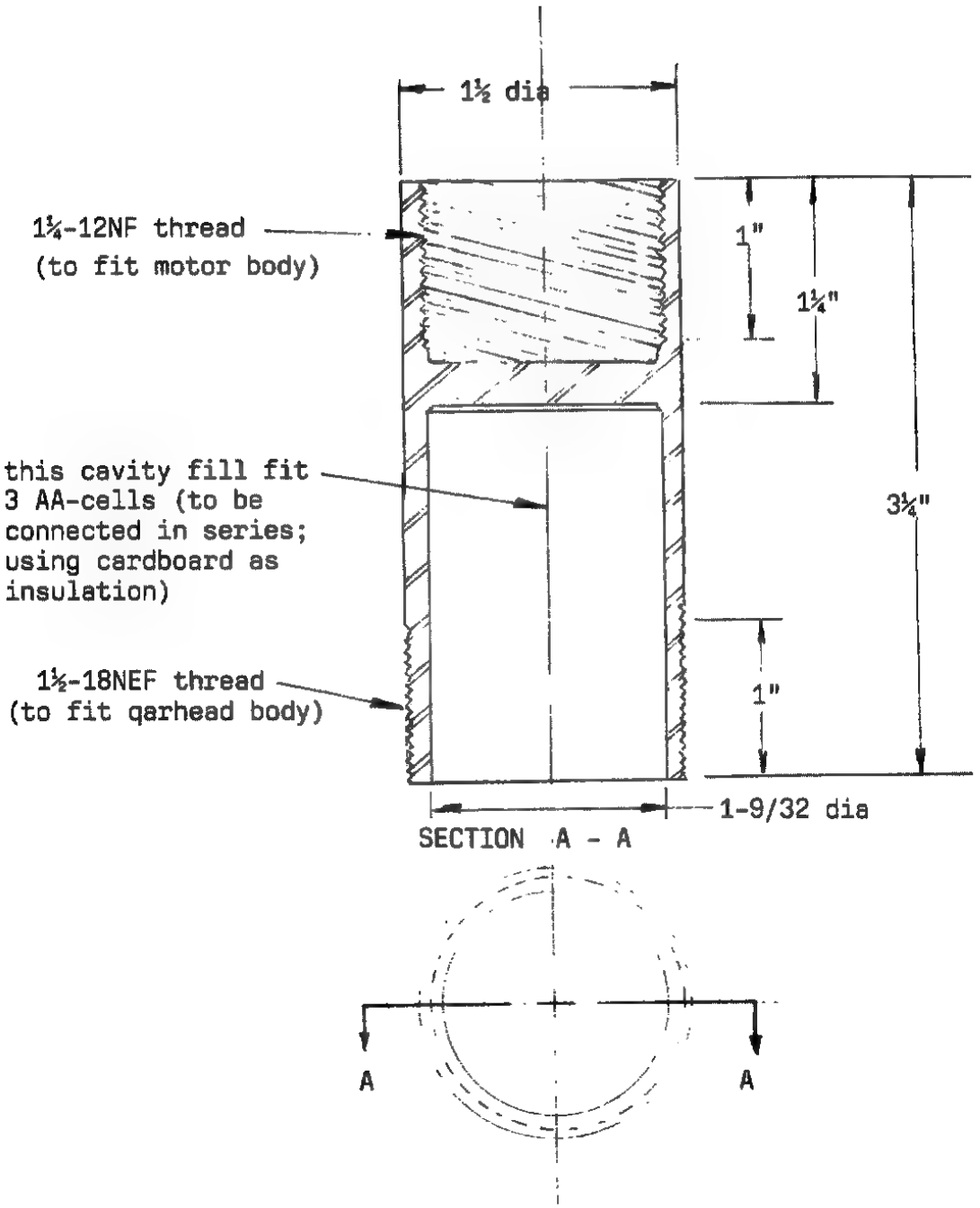


TAMPING FIXTURE FOR COMPACTING PROPELLANT (BLACK POWDER) IN A RE-ENACTMENT BAZOOKA ROCKET MOTOR (1 INCH NOMINAL SIZE STEEL PIPE)



TYPICAL RE-ENACTMENT BAZOOKA ROCKET MOTOR FRONT SPACER

Material: steel, hardening grade



To appreciate the difference in handling the crew-served Bazooka under combat conditions, to the Panzerfaust, read the following instructions from a military manual and compare these to the Panzerfaust instructions.

Preparation for Firing

Preparation of Rocket –

After rockets are removed from their packings, they are prepared for firing as follows:

Examine the launcher to make sure that the safety switch of the trigger grip on the electrical firing mechanism is in a "SAFE" position

(1) All 3.5-Inch Rockets

should be examined for loose heads. Examine for a discernible 360° gap between the head and the fuze.

Any round which has a discernible 360° gap between the head and the fuze is not to be fired.

(2) Check rocket for loose nozzle closure by gently pulling the red and green ignition lead wires that pass through the closure. Any movement of the closure indicates failure of bond. A loose closure may result in the rocket falling short or "chuffing" (intermittent burning with a puffing noise) when fired.

(3) Remove the shorting clip from the contact ring assembly of the rocket.

(4) Move the control handle of the launcher forward to the "LOAD" position. Remove the safety band from the fuze, and carefully push the rocket into the launcher tube until the detent engages the continuous groove in the support ring.

Prior to loading the rocket into the launcher, test the ejection pin of the fuze to insure that it is free from binding. This is done by depressing the pin with the fingers and releasing it. If the ejection pin binds while being depressed or twisted, reject the rocket

When loading the rocket into the launcher, depress the ejection pin with the fingers until the pin is in the bore of the launcher. Make sure that the pin is pointed downward or to the side. Failure to hold the ejection pin depressed while loading the rocket may result in the pin coming in contact with the breech end of the launcher tube and thereby becoming bent. Failure to point the ejection pin downward or to the side may result in the pin striking the position stops and becoming bent. Observance of these procedures gives greater assurance of proper functioning of the rocket.

(5) When ready to fire move the handle forward to the "FIRE" position.

Precautions In Firing

Rockets should be free of sand, mud, moisture, frost, snow, ice, grease, or any foreign matter. If rockets become dirty or wet, they should be wiped off at once with a clean, dry wiping cloth.

Do not drop the muzzle of the launcher immediately after firing, because the rocket may strike the foreground and cause serious injury to personnel.

Do not fire rockets at temperatures below −20° F. or above +120° F. These temperature limits are marked on the rocket and are specified as the safe temperature limits.

Do not fire rockets with damaged fins or motors. Damaged motors may cause dangerous pressures. Damaged fins will cause erratic flight.

Be careful when loading rockets into the launcher to prevent damage to the fins of the tail assembly.

Do not jar a loaded launcher.

The rocket must be destroyed as soon as practicable if the ejection pin is not in place in accordance with TM 9–1300–206.

When loading the rocket into the launcher, depress the ejection pin with the fingers until the pin is in the base of the launcher and make certain that the pin is pointed downward or to the side. Failure to hold the ejection pin depressed while loading the rocket may result in the pin coming in contact with the breech end of the launcher tube and thereby becoming bent. Failure to point the ejection pin downward or to the side may result in the pin striking the position stops and becoming bent. Observance of these procedures gives greater assurance of proper functioning of the rockets.

Observe the *Warning*

relative to protection of the eyes and/or face and hands.

The following additional precautions will be observed in firing rockets in freezing weather.

Rockets will function normally at any temperature between the temperature limits marked thereon. However, there are certain precautions which should be observed to insure more reliable functioning when the atmospheric temperature is below 32° F., particularly during rainstorms, snowstorms, or in an atmosphere sufficiently humid to cause icing or frost. When rockets are subjected to temperature fluctuation, which may loosen the nozzle closure, moisture may enter and subsequently form ice or frost within the motor.

Protect the fuze cavity against the entrance of moisture. The safety band, which is around the fuze, depresses the ejection pin of the fuze M404 series and seals the fuze against the entrance of moisture. When the band is removed preparatory to firing, moisture, if present, can enter the fuze cavity. Under these conditions, if considerable time elapses between removal of safety band and firing, moisture may have entered the fuze cavity and frozen.

Rockets Prepared for Firing but not Fired—

(1) Before unloading the launcher, make sure that the safety switch of the trigger grip on the electrical firing mechanism is in a "SAFE" position.

(2) Move the control handle forward to the "LOAD" position. Raise the detent spring assembly, and *carefully* withdraw the rocket from the launcher tube. *Install the safety band over the ejection pin and replace the shorting clip.*

(3) Rockets prepared for firing, but not fired, will be returned to their original condition and packings and will be appropriately marked. Such ammunition will be used first in subsequent firings in order that stocks of opened packings may be kept at a minimum.

Chapter V

The Panzerfaust

The spectacular performance of the Bazooka in North Africa against the German tanks did not go unnoticed. The German Army copied the Bazooka (under the name "Panzerschreck") but it was a failure. Then in October 1943 the Germans introduced the first Panzerfaust. Even though the first model (Panzerfaust 30 klein) was lacking in performance; the basic concept was sound. The model Pzf 30 was quickly superceded by Pzf6O, Pzf100 and Pzf15O. The model numbers referred to the sighting effective range while the armor penetration of all three models was kept at 200 millimeters. Since the summer of 1944 the production of Panzerfausts was in excess of 200 thousand units per month.

The Panzerfaust was not only the first EXPENDABLE weapon of this type, it was carried and fired by only one man. The Bazooka required a two man team and the launcher was not discarded after firing. Following are some data on the Panzerfaust:

MODEL	30Kl.	30	60	100	44-IAI4	4-2A1	Pzf3
Launcher							
Length mm	800	800	800	800	880	880	900
Weight gram	1475	5220	6800	6800	7630	7140	2400
Tube cal.mm	31.5	44	44	44	44	44	60
Warhead dia. mm	100	150	150	150	81.5	67	110
Muzzle vel. m/ sec	30	30	45	62	107	168	170
Eff. range,m	30	30	60	100	200	400	400
Penetration at 90° mm	144	200	200	200	375	370	600
Field use, year	1943	1943	1944	1944	1961	1963	1980
manufacturer	Hugo,Schneider Lampenfabrik,Leipzig				DynamIt-NobelAG Troisdorf		

The Panzerfaust launcher is a steel tube, of smaller diameter and shorter than the Bazooka. Its sights, safety and firing mechanism are even more simple than the Bazooka counterparts. Although the Panzerfaust had an effective range of only about one half of the Bazooka its other advantages of size, weight, handling, etc. made it a model for all future weapons of this class. The following pages show pictures and sketches that illustrate the handling, basic design, and construction of typical Panzerfaust.

Bedienung der Panzerfaust

HANDLING THE PANZERFAUST

PULL THE SAFETY WIRE

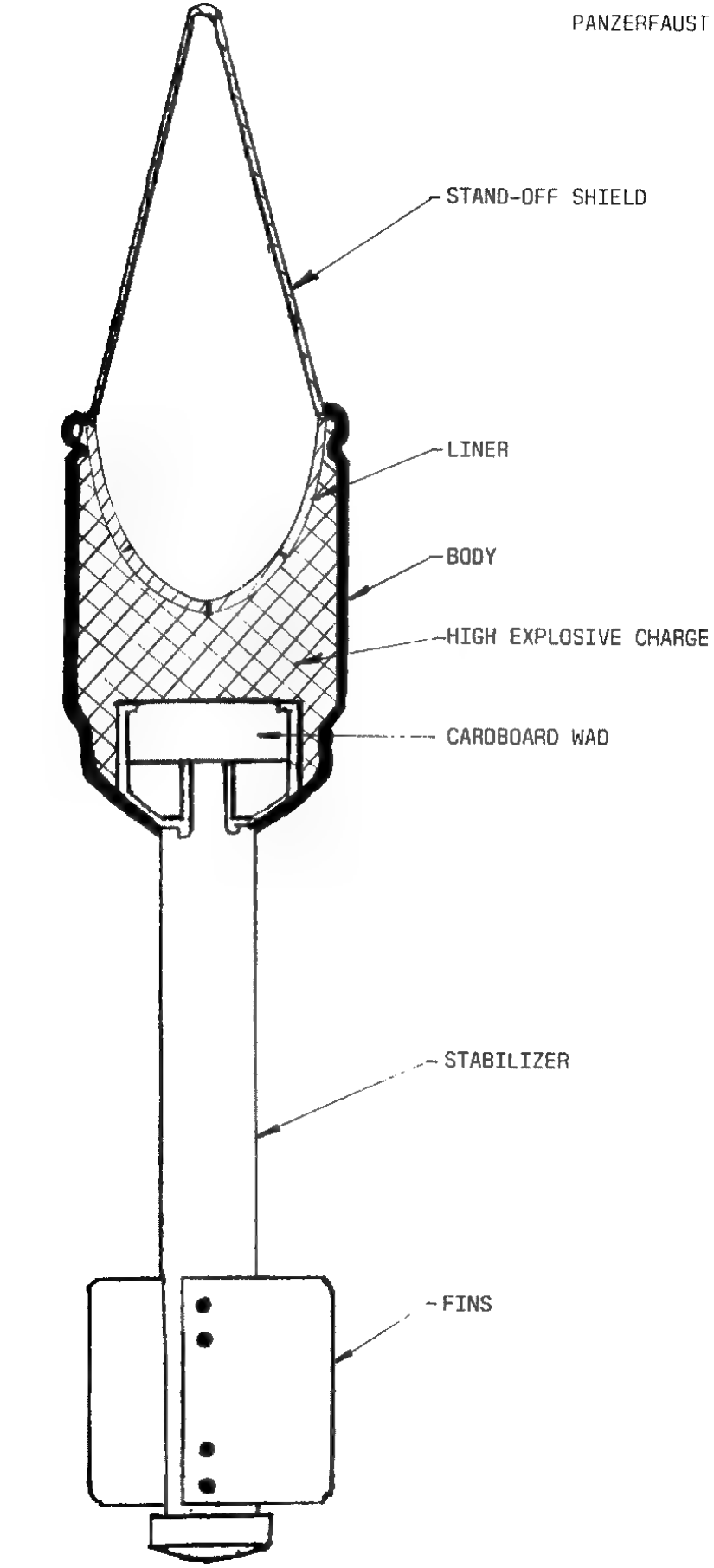
PULL UP THE SIGHT

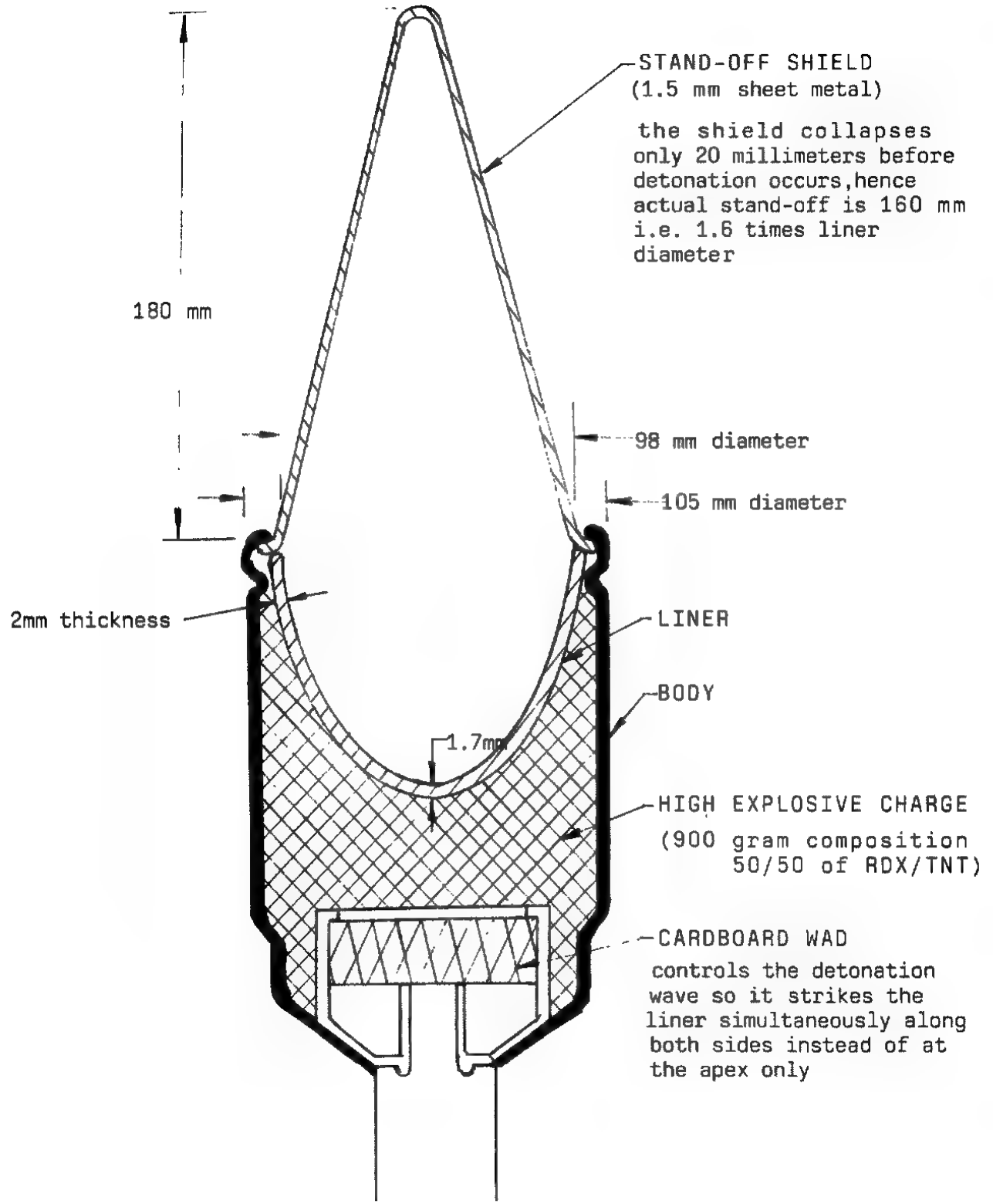
PUSH THE SAFETY "OFF"

PUSH THE TRIGGER TO FIRE

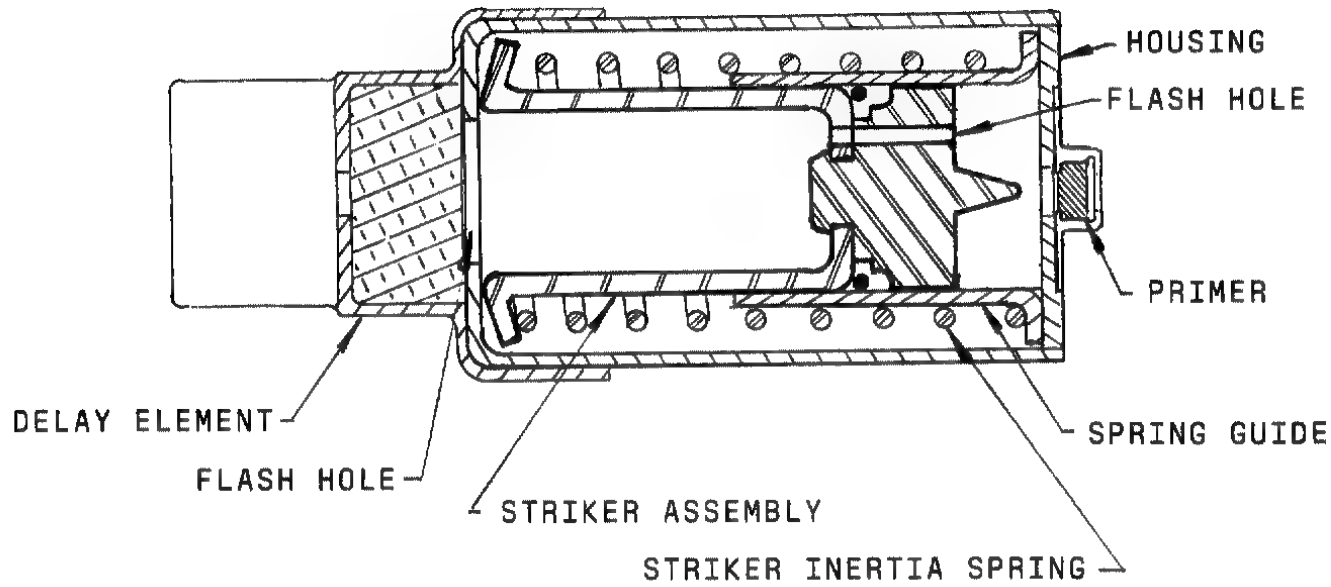
Germany's copy of the Bazooka Panzerschreck

The Panzerfaust




STAND-OFF SHIELD
(1.5 mm sheet metal)
the shield collapses only 20 millimeters before detonation occurs,hence actual stand-off is 160 mm i.e. 1.6 times liner diameter
180 mm
98 mm diameter
105 mm diameter
2mm thickness
LINER
BODY
1.7mm
HIGH EXPLOSIVE CHARGE
(900 gram composition 50/50 of RDX/TNT)
CARDBOARD WAD
controls the detonation wave so it strikes the liner simultaneously along both sides instead of at the apex only

PANZERFAUST FUZE activated by the discharge of the weapon. The primer flash sets off the 3 second delay which in turn ignites the detonator. The delay functions only if the warhead did not strike the target within the time limit. This self-destruct mechanism allows the use of the PANZERFAUST (with fragmentation sleeve) in the antipersonnel role.



DELAY COMPOSITION: (by weight)

BARIUM NITRATE	50%
ALUMINUM POWDER	25%
MAGNESIUM POWDER	25%

The propelling charge in the original Panzerfaust was also a double-base powder. The charge was divided into two increments separated by an air gap. Each increment weighing about 95 grams was enclosed inside a cardboard cylinder (similar in construction to various grenade simulators in current use). A thin paper diaphragm sealed the propellant increments from the air gap. The expelling weight consisted of small metallic chips.

REENACTMENT PANZERFAUST

The reenactment Panzerfaust is the simplest of all reenactment antitank weapons to build. It does not require a large and sophisticated launcher like Bazooka. It does not need a rocket motor. The reenactment Panzerfaust may be constructed from seamless steel tubing of 1 $^1/_2$ inch (32 mm) inside diameter and about 30 inches (760 mm) long. The launcher does not have the front and rear conical protectors of the Bazooka and RPG. Using a simple electrical igniter, described in the text eliminates the more complicated "through the tube" mechanical igniter.

The rudimentary sights and firing mechanism may be cut or molded from wood or plastic and attached to the tube with epoxy adhesive.

PROPELLANT CARTRIDGE

The reenactment propellant cartridge is made from a plastic film can. The top has a hole cut out allowing a tight fit for the electric igniter consisting of a PR2 flashlight bulb filled with FFFG black powder, as described in chapter 2. The cork stopper is not need. The film can is loaded with the desired charge of the propellant. A good starting point may be 10 grams of Red Dot shotshell powder with 5 grams of FFFG for booster. Close the cover, with the flashbulb facing INSIDE the can. The assembly is then secured with adhesive tape (electric, fiberglass, or plastic) so that a pull on the wires will not damage the connections.

If a plastic film can is not available, the propellant case may be formed from a piece of paper rolled over a 1 inch (25 mm) diameter wooden rod. The paper case sealed and taped at one end is pulled off the rod and filled with the propellant. The flashlight bulb igniter is placed over the propellant and the paper case is securely taped all over.

EXPELLING COUNTERWEIGHT

Although the original Panzerfaust used metallic filings as the counterweight material expelled from the rear end, the reenactment unit may use dry sand. Sand is more readily available, environmentally benign and almost as effective as the metal filings.

A wooden rod of about 1 $^1/_4$ inch (32 mm) diameter is used to form the counterweight container body. A sheet of paper is rolled over the rod, closed and taped at the bottom. The resulting paper cylinder should have a sliding fit in the Panzerfaust launcher. A 1 $^1/_2$ inch plastic tubing used as for sink trap acts as a holder for the paper case while it is filled with sand. A paper case will expand during filling if not supported. The screened, fine sand filler does not produce a long range and dangerous rear blast area. The sand filler is compacted by tapping the tube (and paper case inside) bottom on a hard surface. When the paper case is full, the top is closed and taped over in the same manner as the bottom. The paper counterweight (inside the tube) is weighted and the weight is recorded on the sealed end. Depending on the components and the overall length of the case, the weight may be about 500 grams for a 250 mm long

case. It is to be remembered that the total weight of the expelled matter must be equal to the total weight of the projectile to assure recoilless performance.

REENACTMENT WARHEAD

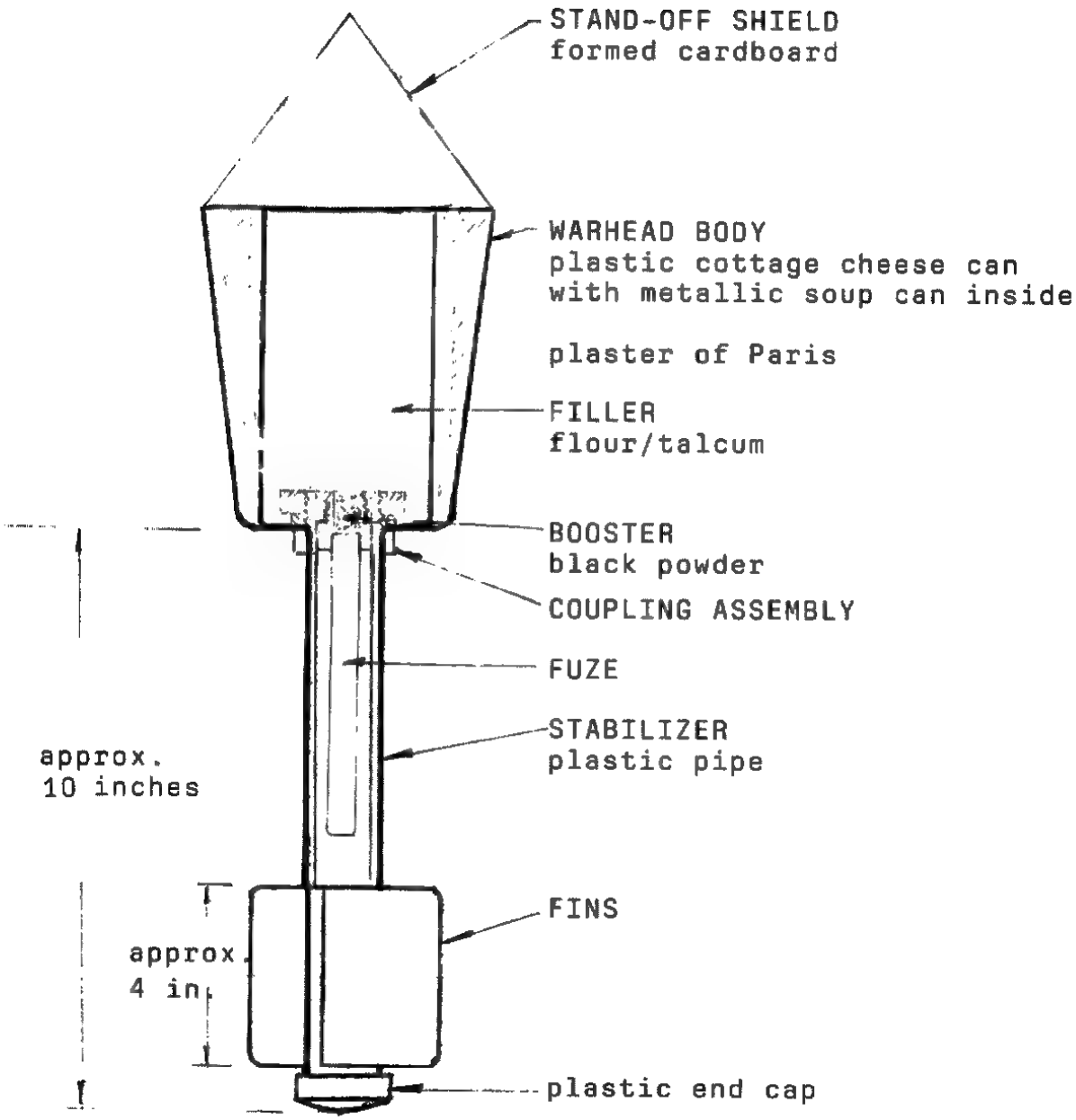
The warhead most readily available which has the typical Panzerfaust-like shape is a 24 oz. cottage cheese plastic can. This container, however is not very rigid and requires a metallic can (from soup or milk) to give it the necessary structural strength. A 1 $^{3}/_{8}$ inch carpenter drill bit is used to cut a hole in the center of the can bottom. A similar hole is cut in the plastic can using a sharp knife or scissors. Both cans are slipped over the threaded coupling (plastic-can on the outside, the metallic can on the inside. A threaded reducer nut is then screwed over the assembly to secure it in place. A plastic washer cut from a suitable material may be needed to give a tight and solid connection. Into the inside of the front end of the coupling is seated and cemented a unit consisting of a $^{1}/_{2}$ inch connector threaded into a $^{3}/_{4}$ to $^{1}/_{2}$ inch reducer. It is necessary to reduce the outside diameter of this reducer to give it a sliding fit in the front end of the coupling. Care must be taken to make the whole assembly so that the fuze primer flame will have a short passage to reach the black powder charge of the reenactment warhead.

A mix of plaster of Paris is poured into the space between the cans of the warhead and allowed to dry (warhead is kept in a vertical position). After drying, the warhead is inspected to assure that the plaster is filling the space uniformly and to the rim of the metallic can. This assures a uniformity of weight around the longitudinal axis of the projectile. A piece of thin paper is then positioned inside the $^{1}/_{2}$ inch opening of the warhead coupling. The cavity is filled with black powder (about 3 grams) and sealed with a paper disc and adhesive. The warhead is then filled with flour, talcum or other powder material. Addition of bright pigment enhances the final impact effect. A suitable diameter cardboard disc is placed over the filler and secured by a solid bead of good adhesive all around. After drying, the assembly is inspected for loose joints and the cardboard standoff shield, previously prepared, is glued over the assembly. Again, after drying the joint is inspected for strength. The joint of the standoff shield and the warhead body is taped over with elastic adhesive tape (plastic electrical tape) around its entire circumference.

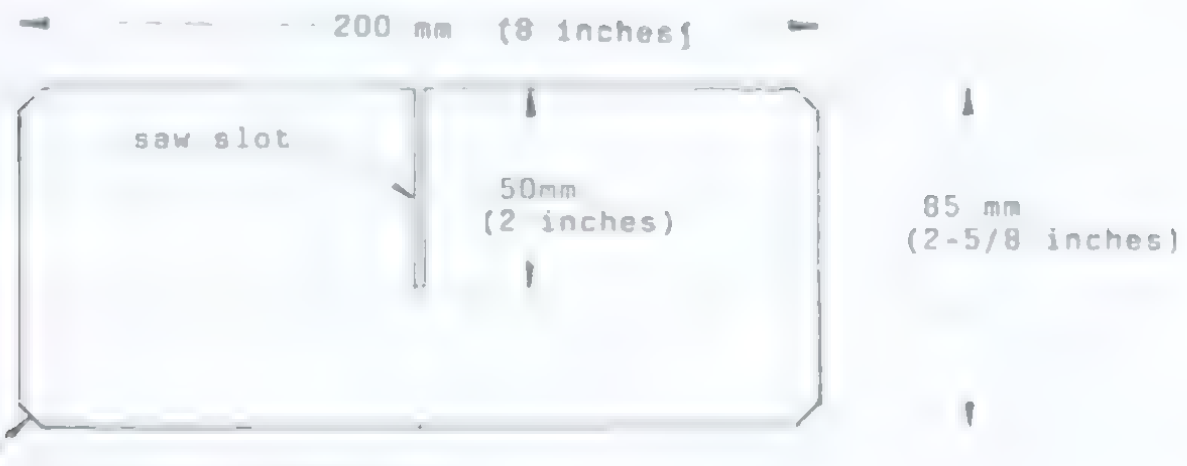
REENACTMENT PANZERFAUST STABILIZER AND FINS ASSEMBLY

The stabilizer body may be constructed from a piece of 1 inch PVCP plastic pipe. The rear end of this tube is cut crosswise with a saw. A band saw is preferred as it produces a straighter cut. The fins are cut with a sharp razor blade from a piece of plastic stationery folder. The fin dimensions are shown on the sketch. This material is strong and elastic to unfold when ejected from the launcher tube. These fins should be as uniform as possible in size and shape . The non-uniformity will affect the overall accuracy of the projectile.

RE-ENACTMENT PANZERFAUST Pzf 60



The fin is inserted into the stabilizer and the fold end is placed with a 1 inch plastic end cap. The cap must be trimmed in order to maintain a good sliding fit inside the launcher



RE-ENACTMENT PANZERFAUST STABILIZER FINS

(required 2 each)

Material: 0.5 mm spring steel or
1 mm plastic office folder (or equivalent)

Note: The uniformity of fins is important to ensure accuracy of the projectile.

REENACTMENT PANZERFAUST, FINAL ASSEMBLY
The steps in the final assembly are as follows:

1 - The fuze is cemented into the base of the warhead coupling.

2 - The stabilizer assembly is cemented into the warhead coupling (over the fuze).

3 - An obturator (a plug from a wet newspaper page) is pushed into the launcher, using a 1 $^{1}/_{2}$ inch diameter wooden ramrod marked with the necessary distances).

4 - The grenade-projectile is pushed into the launcher till it rests against the obturator.

5 - From the rear end of the launcher, the propellant cartridge is pushed in till it rests against the back end of the obturator. The ends of the igniter wires must be outside the launcher.

6 - Another obturator (wet newspaper page) is pushed in till it rests against the propellant cartridge.

7 - The expelling counterweight is pushed into the launcher by holding the plastic tube in line with the end of the launcher and pushing the counter-weight with the wooden ramrod.

8 - The rear end of the launcher is taped over.

9 - One of the igniter wires is connected to the ground (-) end of the battery.

10 - When ready to fire, the other igniter end is connected to the hot (+) end of the battery.

11 - The reenactment Panzerfaust is fired by pushing the battery switch.

NOTES:

a - Lighter projectile requires less counterweight and smaller propellant charge to achieve the same range.

b - Better obturator , formed like an oversize shotshell cup wad will improve the ballistic efficiency and range of the system.

c - When the rear obturator is seated against the propellant cartridge, care must be exercised not to damage the lead wires and the bulb bridgewire by excessive compacting of the obturator.

d - The above described components are relatively heavy; weight was sacrificed for ease of assembly. The fuze weighs 100 grams, the stabilizer/fins assembly weighs 250 grams. The weights and dimensions of the various warhead components are given below.

A lighter reenactment Panzerfaust grenade with a longer range may be built in the same manner as described above, but using the following components:

Warhead body -12-oz. milk can with 5-oz. milk can inside

$^3/_4$ inch coupling with black powder booster

Sand filler or equivalent

Weight 750 grams

Stabilizer and fins assembly:

$^3/_4$ inch plastic schedule 40 pipe, 12 inch long fuze - modified construction using stabilizer pipe as body

Weight 170 gram

Total Weight 970 grams

Propellant : 12 gram Red Dot in plastic film can taped all over

Obturator: wet newspaper

Such reenactment Panzerfaust should have an effective range of approximately 50+ meters.

REENACTMENT WARHEAD BODY MATERIALS

ITEM	OUTSIDE DIAMETER	CAPACITY	WEIGHT CONTAINER & SAND	REMARKS
	mm	ml	gram	
5-oz milk can	$64^{1}/_{2}$	170	330	fits snugly inside soup can
soup can	$67^{1}/_{2}$	330	550	
12-oz milk can	75	400	650	fits nicely inside 3 inch PVC pipe
corned beef hash can	86	450	770	
24-oz plastic cottage cheese can	115	670	1100	
cardboard toilet paper core		98		

Note: 1- 3 grams FFFG volume is 3.2 ml

2 - shotshell primer sensitivity specs; to fire - 57 gram ball drop height 210 mm (firing pin tip dia. 1.3mm radius)

Chapter VI

Russian RPGs

The most common type of shoulder-fired antitank weapon used in the wide world today is the Russian RPG series. The RPG (Ruchnoi Protivotankovii Granatomet Hand-held Antitank Grenade launcher) combines the best features of the Bazooka and the Panzerfaust into a formidable, yet simple system.

The launcher is a short and small-diameter tube. The projectile with the propelling charge is loaded from the muzzle (front) end. This allows the rocket motor and the exhaust nozzle to be integral with the rear end of the tube. Furthermore, the small tube diameter allows higher propellant pressures (with improved burning characteristics) without undue tube stresses. This is comparable to a revolver cylinder where the .45 long Colt cartridge with low pressures produces the same wall stress as a .357 Magnum high pressure load.

The mechanical firing mechanism is contained in the pistol grip. The rear end of the launcher is protected from damage by a flared disc. To isolate the user's body from contact with the hot launcher, a wooden cylinder is slipped on and secured over the steel tube. The launcher is non-expendable. Although the organization charts show the RPG as served by a crew of two, the muzzle loading method allows a one man operation. Since the RPG has a gas escape hole on the right side of the tube, opposite the pistol grip, it cannot be fired from the left shoulder.

The early (PG-2) projectile used a simple propellant charge, while the warhead stabilizer unit was practically a copy of the Panzerfaust. The grenade underwent a number of modifications and improvements. The current PG-7V uses an improved propelling charge to launch the projectile. After leaving the muzzle and while in flight, away from the user, the rocket in the projectile stabilizer body ignites. The rocket motor nozzles are inside the star-shaped unit. To stabilize the projectile in flight, a tail-boom with fins slides out of the stabilizer end.

The Panzerfaust was preloaded and assembled at the factory so it did not require attention to the projectile loading procedure. However, the RPG projectile is loaded from the muzzle by the operator. There must be a detent (knob-like projection) which orients the projectile assembly so that the primer of the ignition cartridge is located in line and right above the firing pin of the launcher.

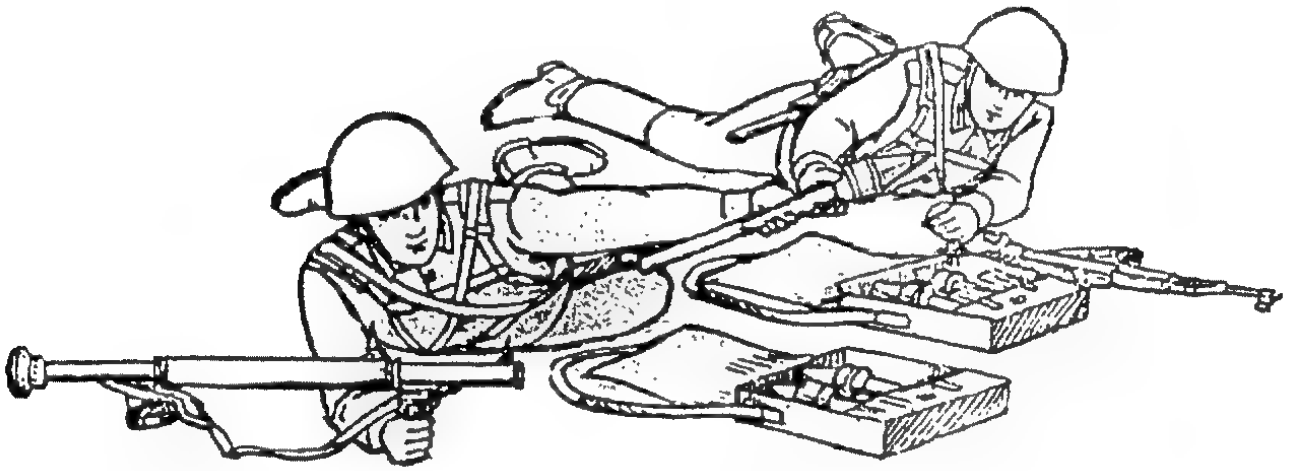
This launching arrangement forms basically a two-stage rocket with improved efficiency and lower weight as compared with previous systems. The PPG has been copied and modified by Dynamit-Nobel model DM-32 and various Fritz Werner models, amongst others.

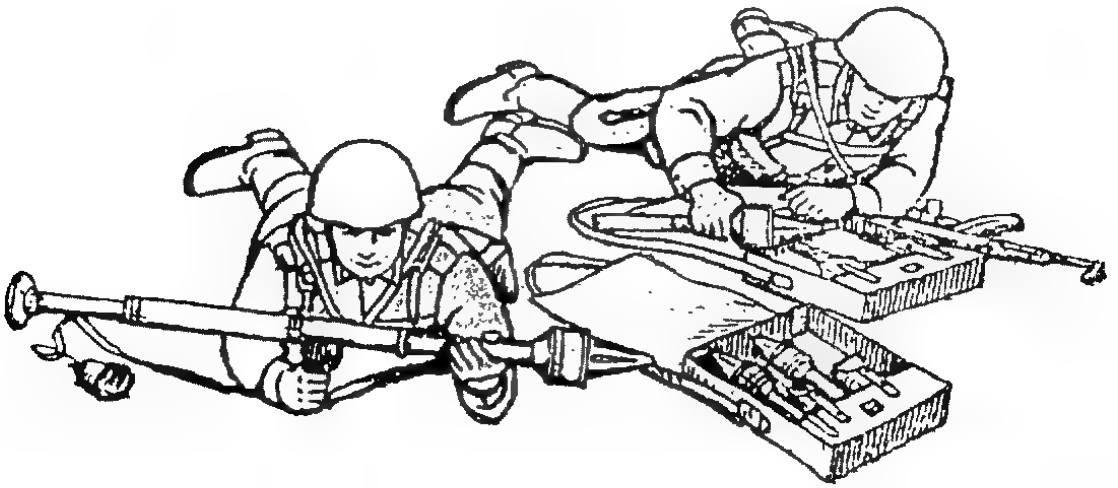
The RPG data are given below:

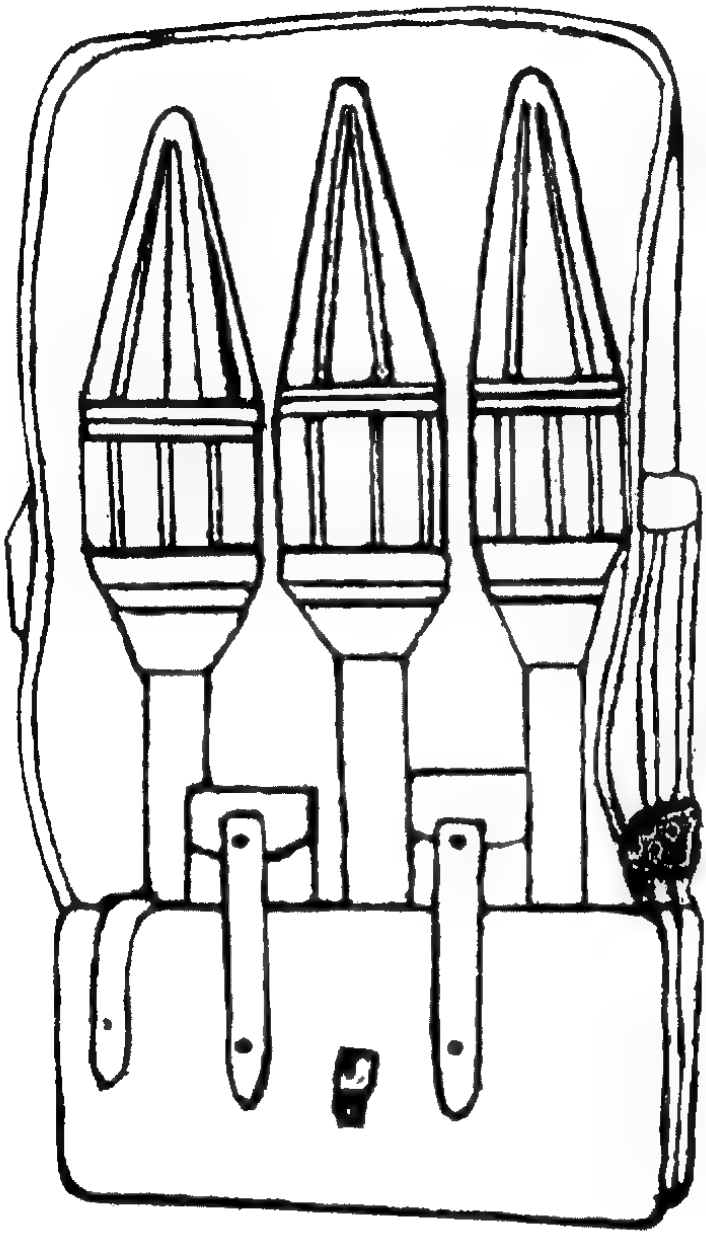
Model	RPG-2	RPG-7V	DN-32
tube caliber, millimeters	40	40	44
tube length - millimeters	950	950	880
launcher weight , gram	2860	6300	
round length , millimeters	670	925	
round weight, gram	1840	2200	2500
warhead diameter, millimeters	80	85*	67
warhead length, millimeters	500	925	550
warhead weight, gram	1620	1750	1500
muzzle velocity, mlsec	84	100	168
maximum velocity, m/sec	84	300	210
effective range, meters	150	300+	300+
maximum range, meters		920	
armor penetration at 0°, millimeters	180	320	370

Note: *The latest RPG-7 warhead has been reduced by 3 millimeters to be standardized with the SPG-9 recoilless gun.

CHAPTER 6

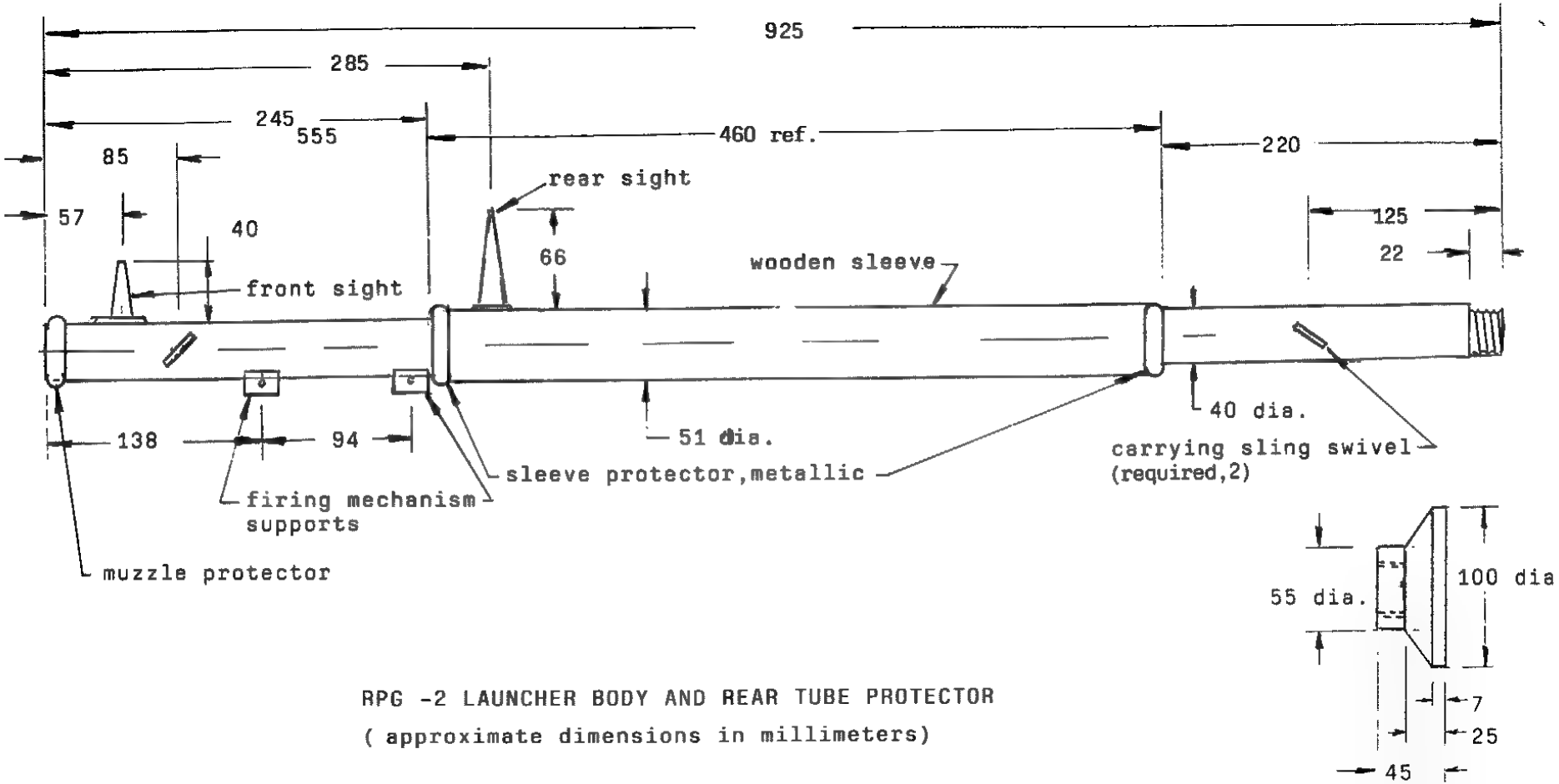






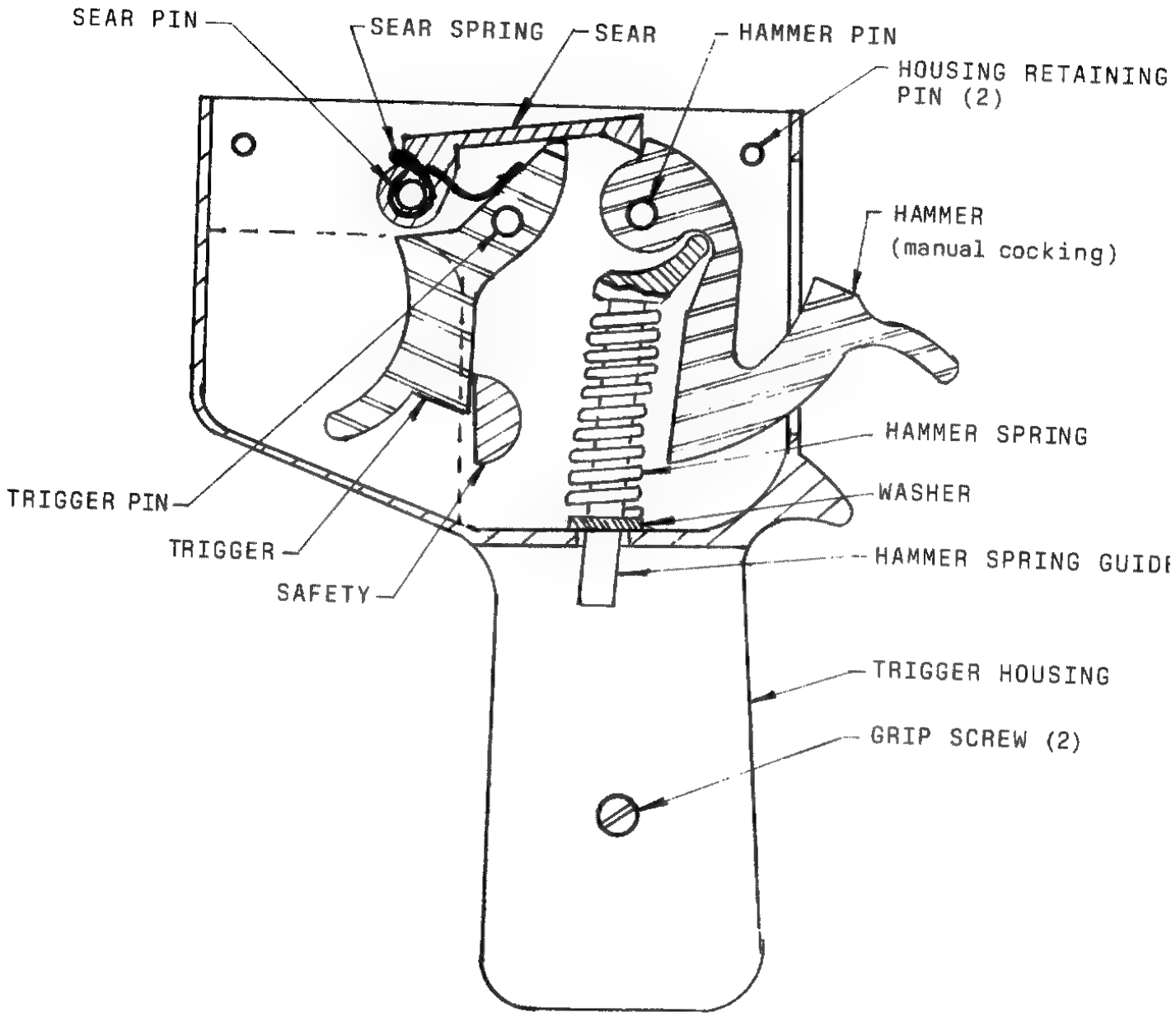
RPG ROCKET CARRY POUCH

Material: green canvas
brown leather straps
riveted to canvas

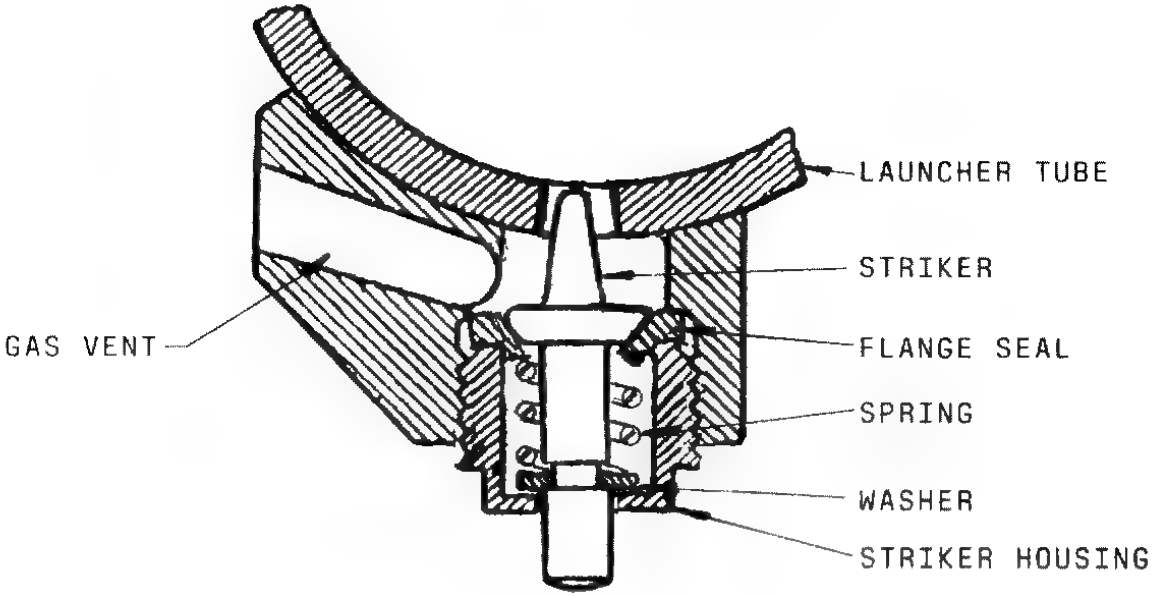


RPG -2 LAUNCHER BODY AND REAR TUBE PROTECTOR

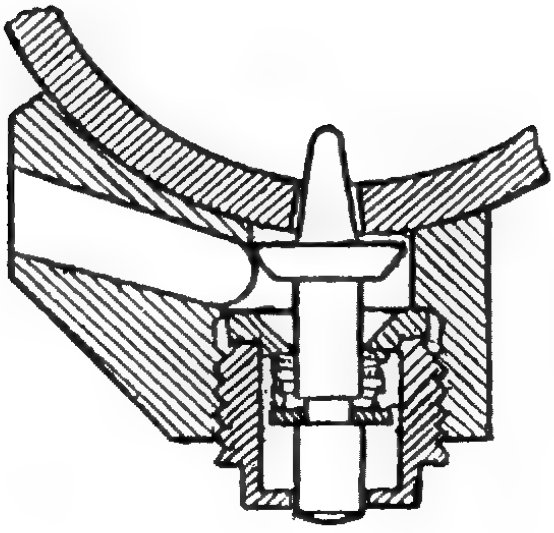
(approximate dimensions in millimeters)



FIRING MECHANISM (mechanical) OF THE RPG - 2



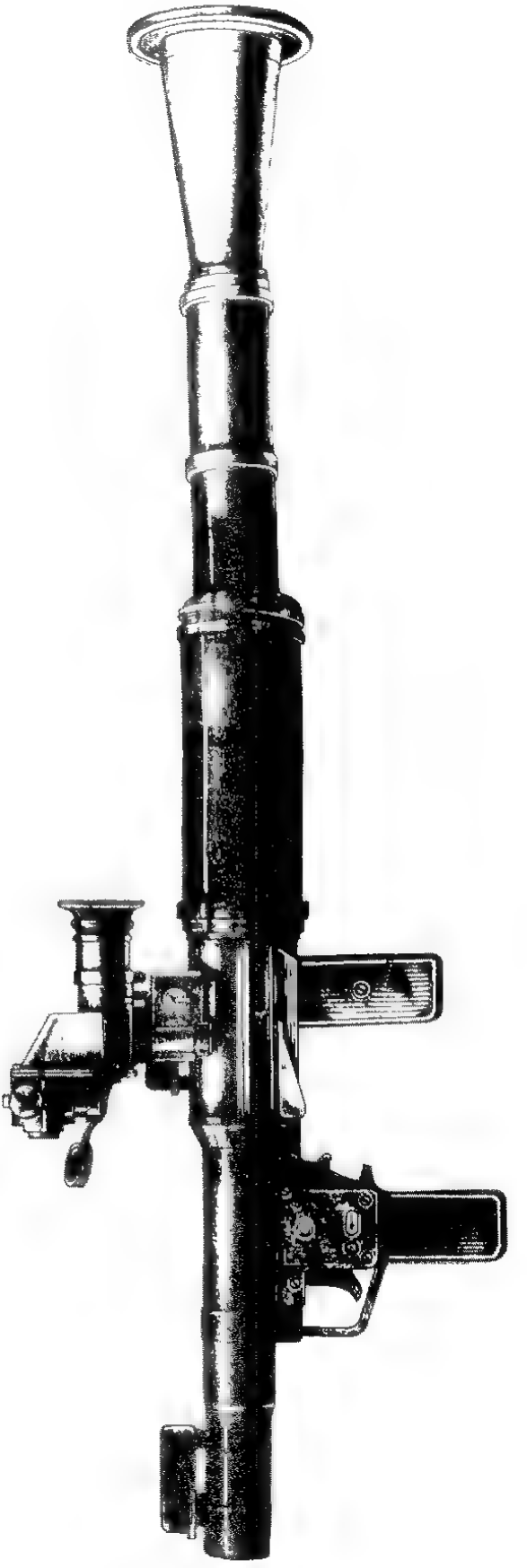
COCKED POSITION



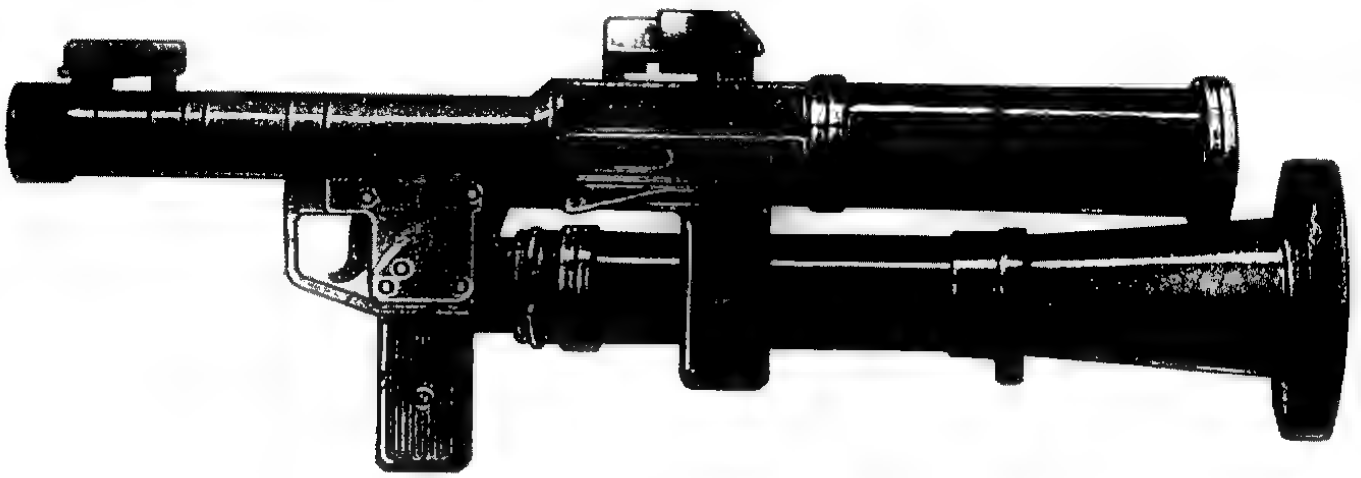
POSITION AT THE INSTANT OF FIRING

RPG-2 STRIKER SYSTEM (view from the muzzle)

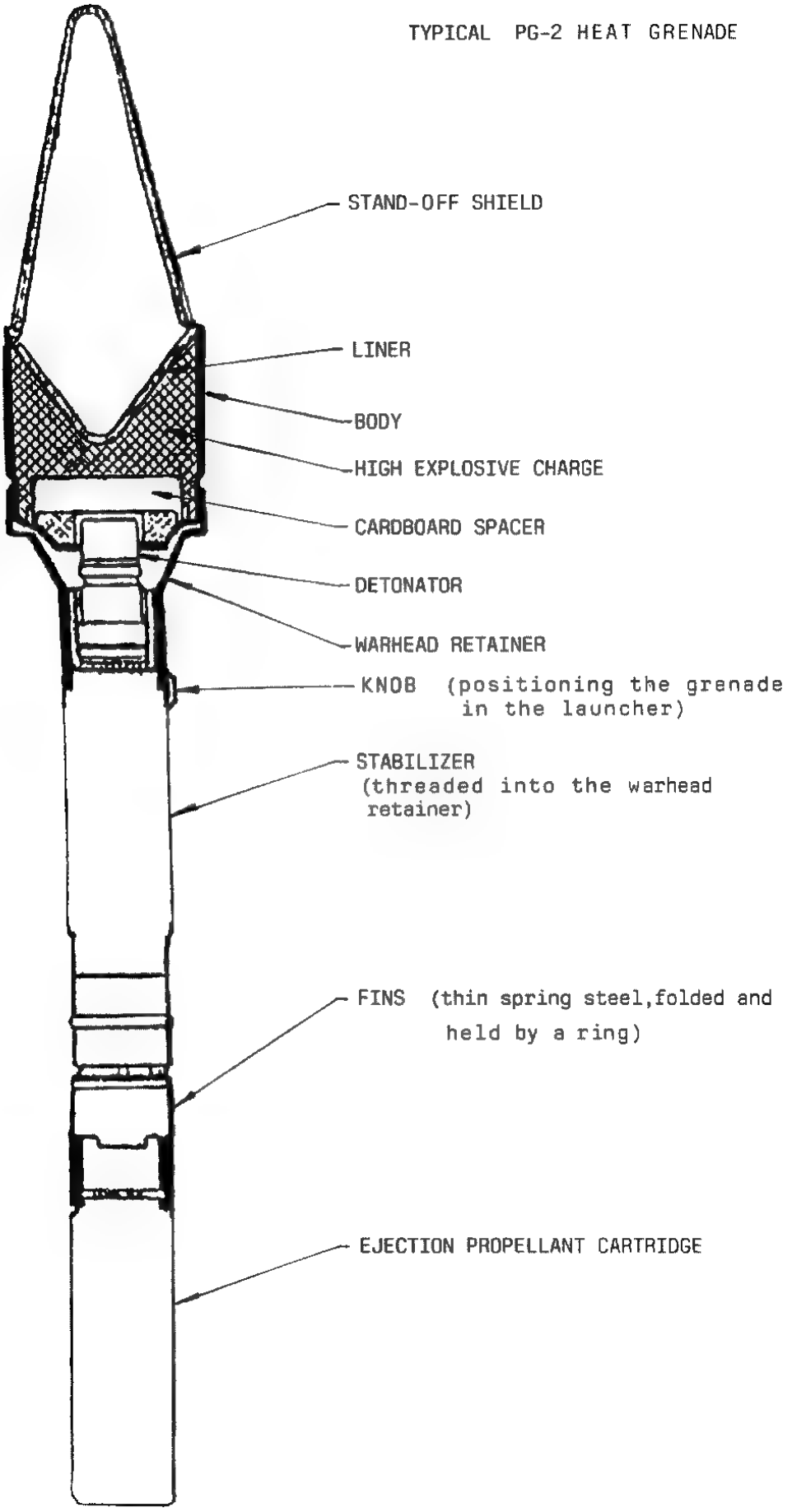
Note: the striker and the flange have tapered seats to prevent any gas escape from the launcher into the firing system. Any gas escape is through the vent on the right side of the unit.

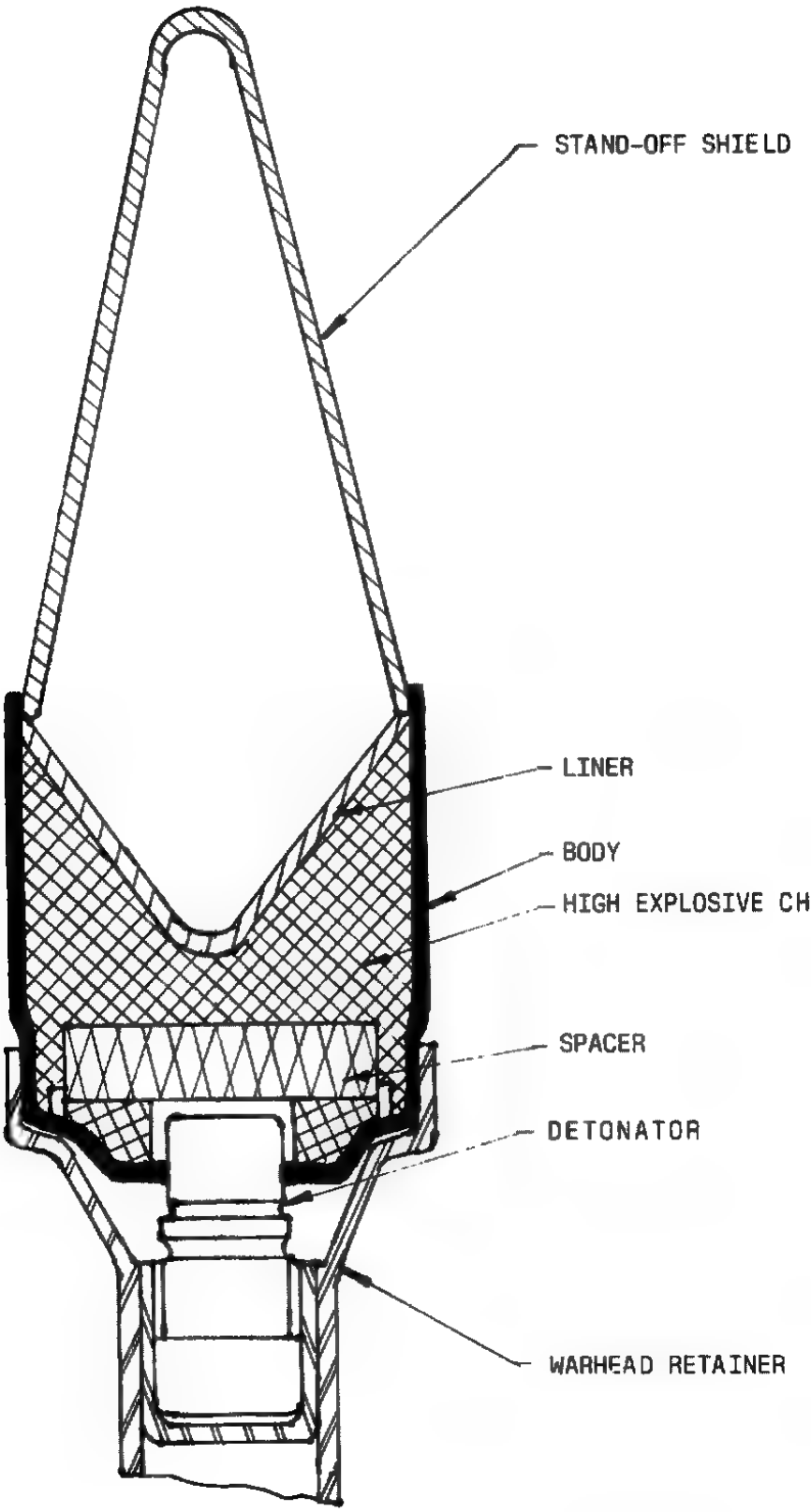


RPG-7D

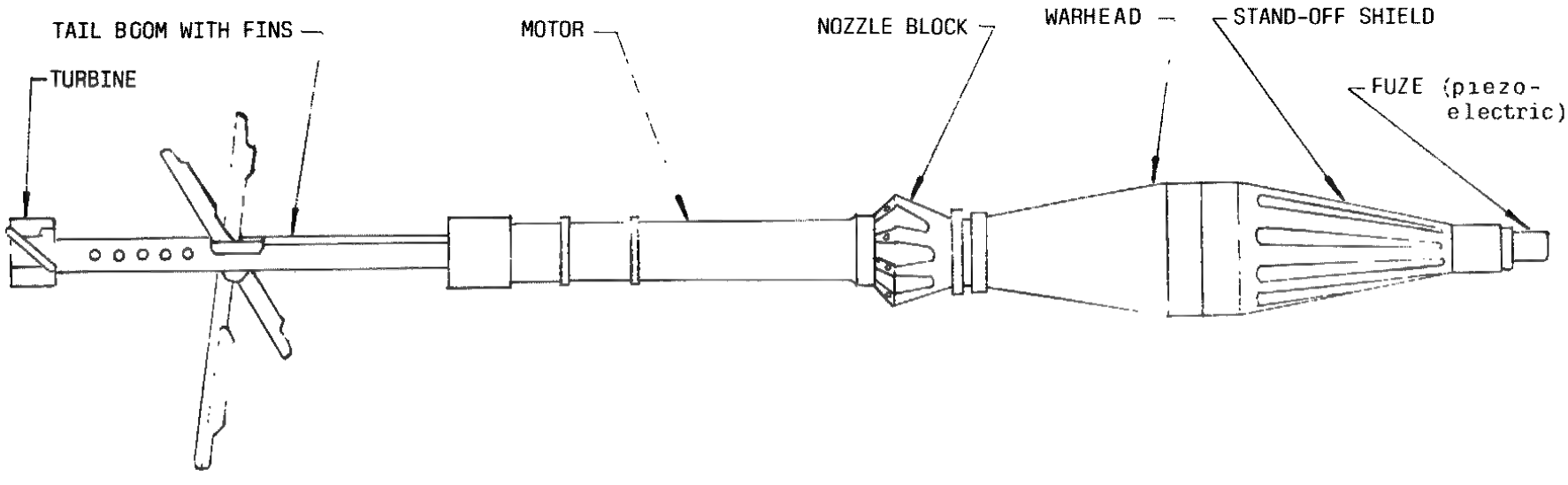


RPG-7D in folded position


TYPICAL PG-2 HEAT GRENADE
STAND-OFF SHIELD
LINER
BODY
HIGH EXPLOSIVE CHARGE
CARDBOARD SPACER
DETONATOR
WARHEAD RETAINER
KNOB (positioning the grenade in the launcher)
STABILIZER (threaded into the warhead retainer)
FINS (thin spring steel,folded and held by a ring)
EJECTION PROPELLANT CARTRIDGE



TYPICAL PG-2 HEAT WARHEAD



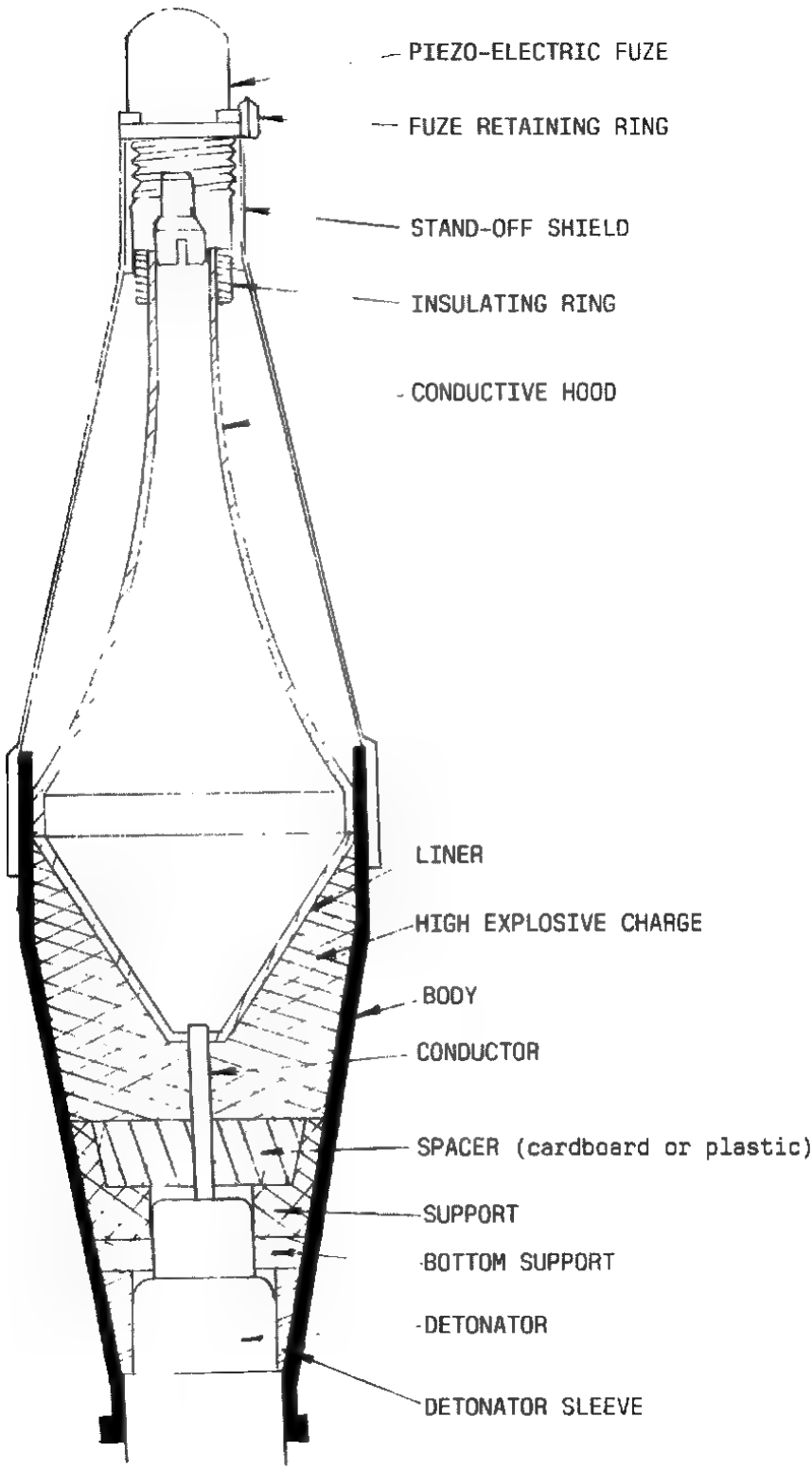
TYPICAL PG-7V HEAT GRENADE

Note: fluting of the stand-off shield allows lighter construction with the same structural stregth as smooth cone;

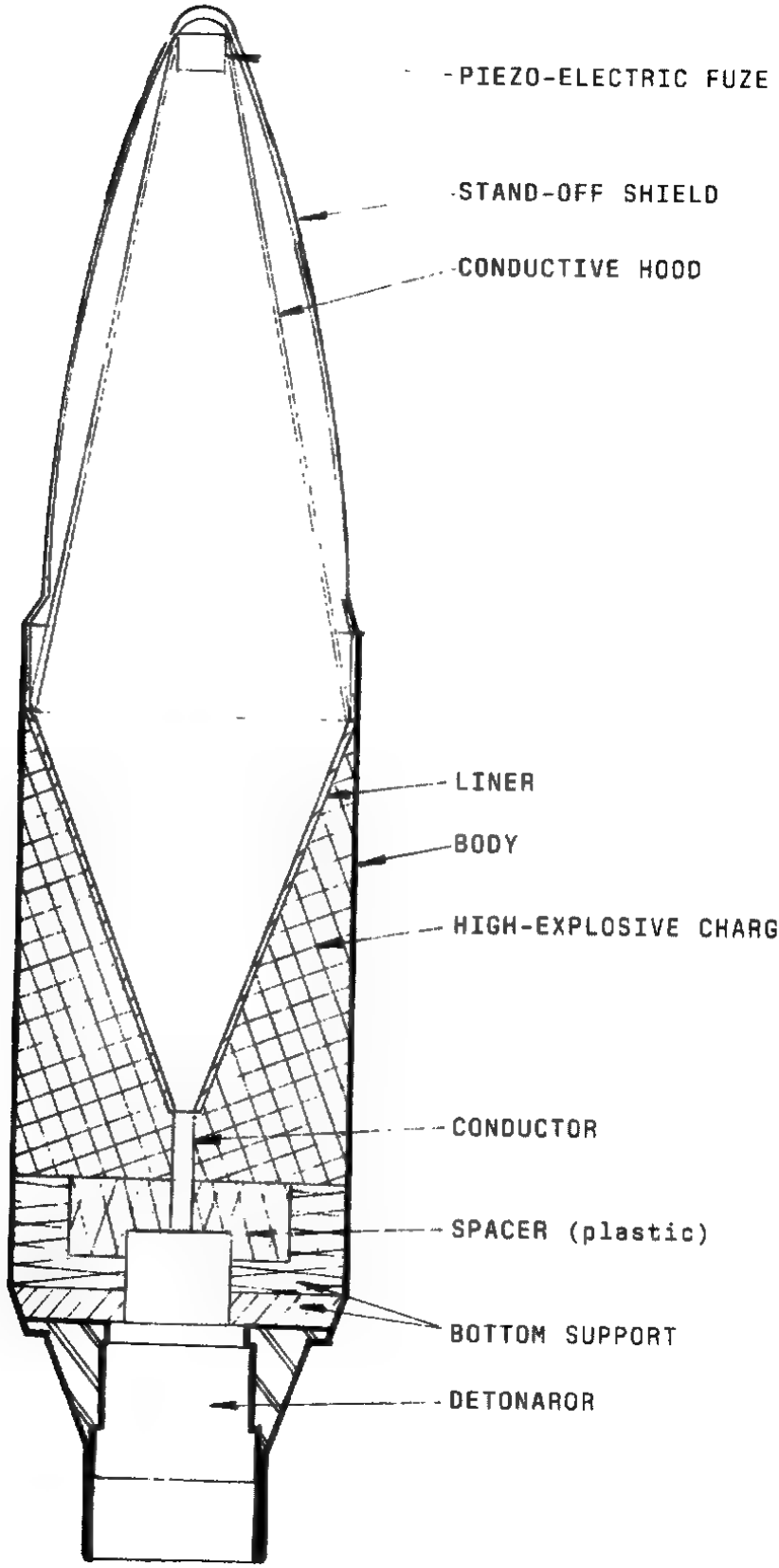
turbine at the end of tail boom and the extended tail boom improve in-flight stability;

like Panzerfaust, the PG-7 has a delay element activating the detonator in case of the fuze misfire, or when missing the target; this feature also allows using the grenade in the anti-personnel role.

TYPICAL PG-7 WARHEAD CONSTRUCTION

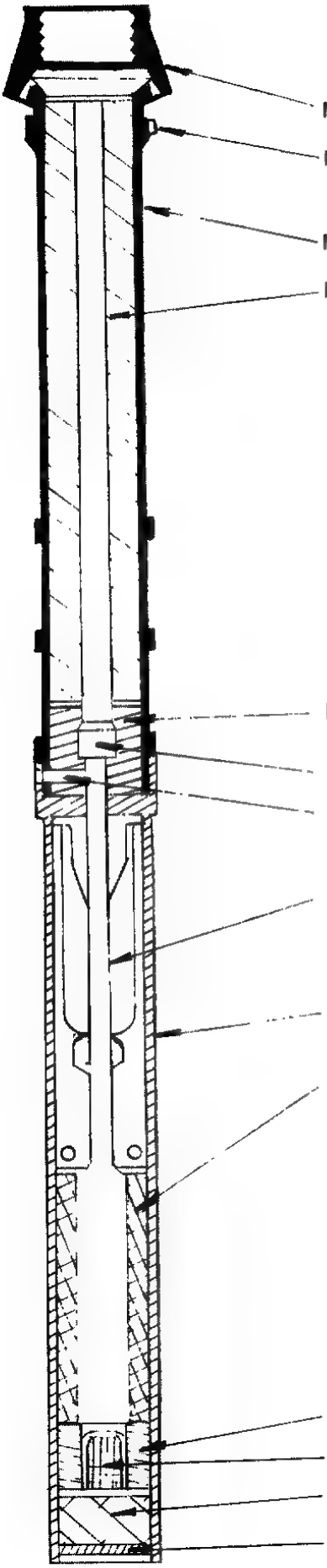


WEST EUROPEAN MODIFIED COPY OF PG - 7 WARHEAD



Note: the components have improved ballistics and simplified manufacture - assembly

PG-7 ROCKET MOTOR AND BOOSTER



NOZZLE BLOCK

KNOB (to position the rocket in the launcher so that the firing pin hits the primer)

MOTOR BODY

ROCKET PROPELLANT

BOTTOM

IGNITER

PRIMER FLASH HOLE

TAIL BOOM WITH FOLDED FINS

CARDBOARD BOOSTER BODY

DOUBLE BASE PROPELLANT

PLASTIC SPACE

TRACER PELLET (in boom bottom)

POWDER PELLET

BOTTOM SEAL

CHARACTERISTICS OF THE RPG18 HEAT ROCKET

Caliber of tube	mm	64
Length of launcher: folded	mm	715
Ready to fire	mm	1050
Weight of launcher	gram	1300
Length of round	mm	700
Length of warhead	mm	325
Velocity, maximum	m/sec	115
Effective range	m	200
Armor penetration at 90°	mm	375

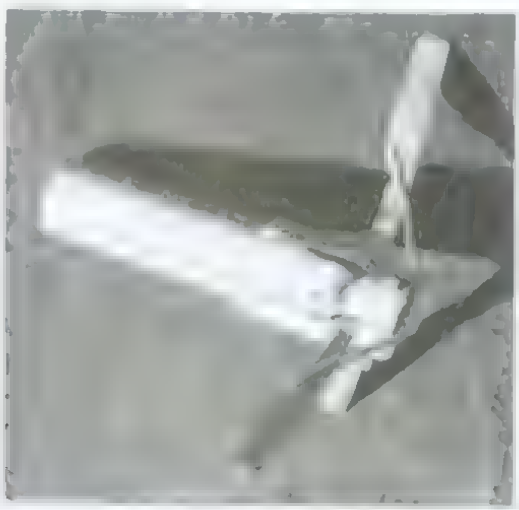
Note: The RPG18 is closer to the LAW than to the older RPG's by using a self-contained extendable tube launcher.

The reenactment RPG launcher may be constructed in a manner similar to the making of the Frankenrocket. The pistol grip, cut from a piece of $^{1}/_{2}$ inch steel tubing, the front and rear sights (also made from suitable pieces of steel, can be welded or brazed to the tube body. The wooden heat shield, cut and formed to shape from thin wood, is secured to the tube by adhesive. The rear cover (not shown) is formed from a metal lampshade (such as used for floor lamps) trimmed and shaped to fit over the tube. The whole launcher (except the wood) is painted dark green or black.

FOLDING FINS TAIL SECTION FOR REENACTMENT RPG OR LAW PROJECTILES

Material $^{1}/_{2}$ inch plastic plumbing component, strip of aluminum siding, tooth picks and rubber bands

Fins Folded. The rubber band holding the fins folded is not used when the assembly is inside the respective launcher



Fins Open

Chapter VII

M72 - LAW

This chapter provides some basic information on the M72 LAW (Light Antitank Weapon). The LAW does not fall into the category of WWII reenactment materiel, but since it incorporates many features of its predecessors, it serves as a source of data usable in the construction of such reenactment units.

LAW is the first truly self-contained and packeted system of this type. Developed in the 1960's, put into service in the 70's, it still remains in use today. Surprisingly, in physical characteristics of size, weight, and performance, it is closer to the 2.36 inch rocket than to the later models.

CHARACTERISTICS OF THE M72A2 HEAT ROCKET

Caliber of tube	mm	68
Length of launcher; folded	mm	654
Ready to fire	mm	893
Weight of launcher	gram	1360
Length of round	mm	508
Length of warhead	mm	240
Weight of round	gram	1035
Weight of warhead	gram	800 Estimated
Velocity, maximum	m/sec	145
Range, effective	m	200
Armor penetration at 0°	mm	150+ Estimated
Firing mechanism	percussion primer	
Danger zone to rear of launcher	m	20

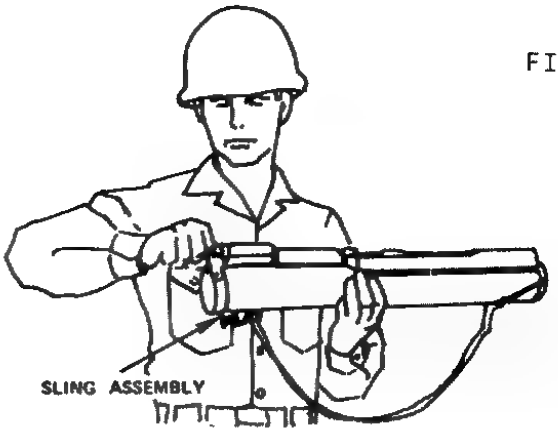
The use of improved propellant, aluminum motor, Octol high explosive and better aerodynamic form make the M72 LAW probably the best unguided, shoulder-fired, expendable weapon of its type today.

The following pages show ROCKET dimensions of the various M72 rocket components and assemblies.

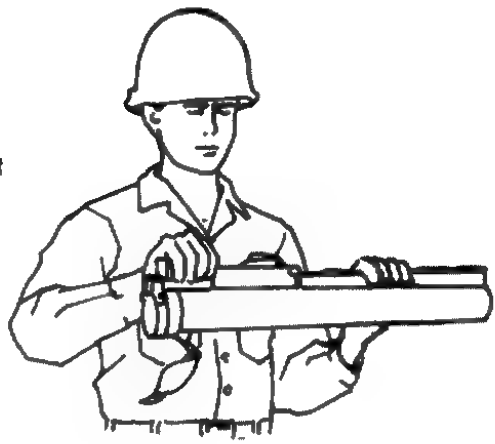
Three basic firing positions of the LAW

FIRING THE LAW

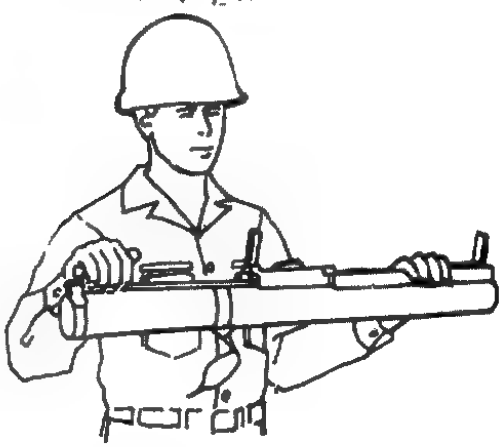
REMOVE PULL PIN AND TOTATE REAR COVER DOWN;
SLING ASSEMBLY FALLS FREE



GRASP REAR SIGHT COVER AND PREPARE TO EXTEND LAUNCHER

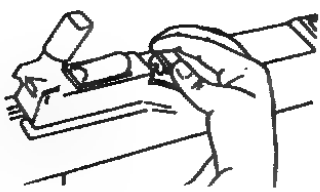


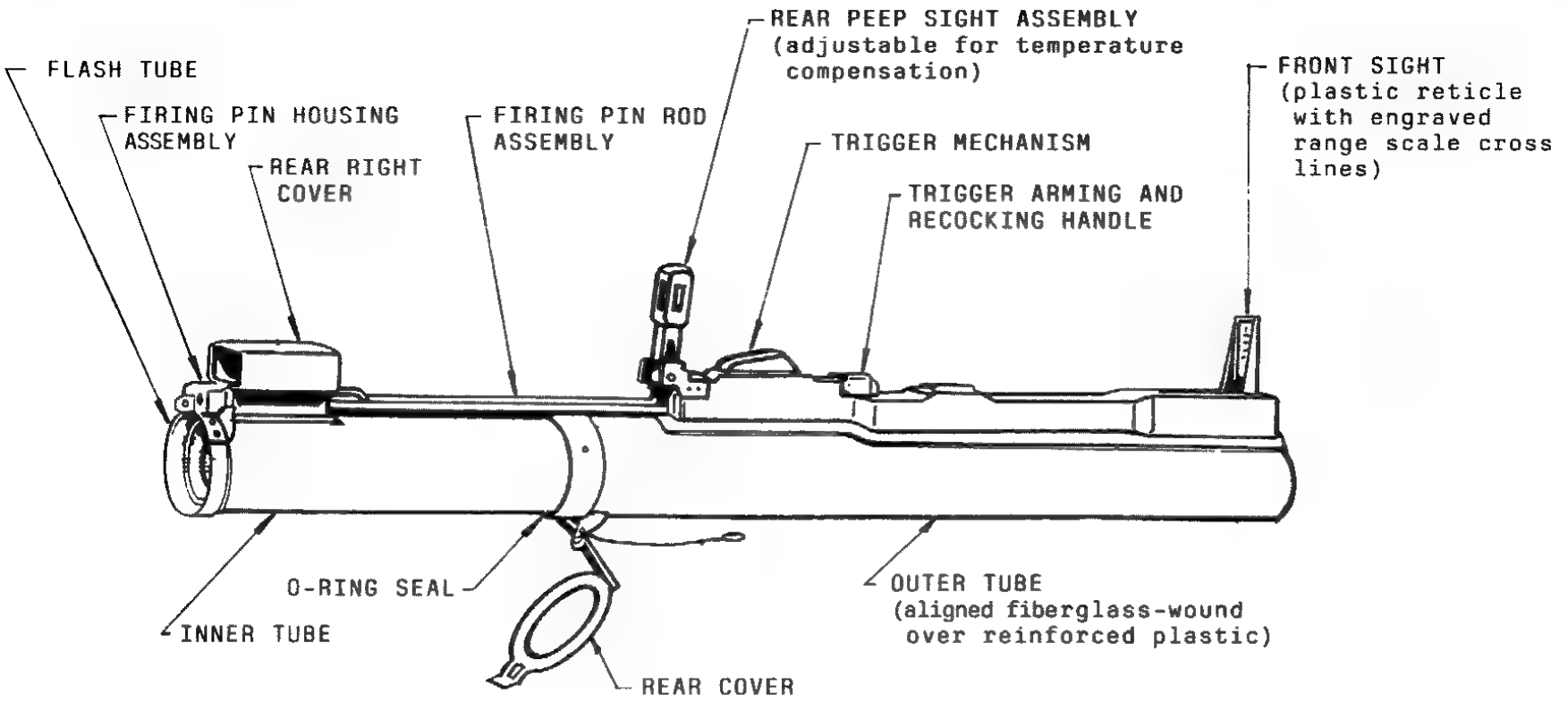
SHARPLY PULL LAUNCHER OPEN UNTILL REAR TUBE LOCKS INTO POSITION



PLACE LAUNCHER ON SHOULDER, PUT IN "ARM" POSITION, AIM, FIRE

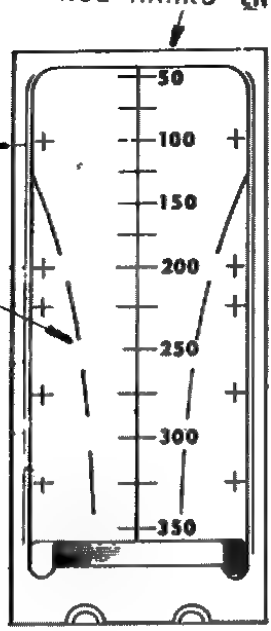
MOVE SAFETY HANDLE TO "ARM" POSITION





U.S.ARMY M-72 LAW

RANGE LINE WITH RANGE MARKS IN METERS



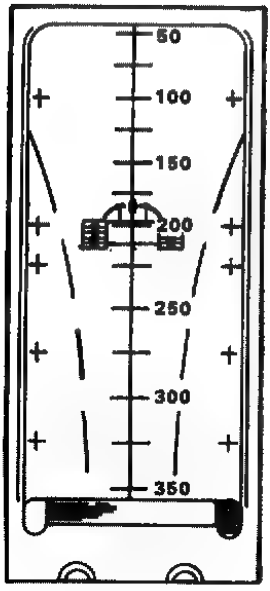
M72 LAW ROCKET

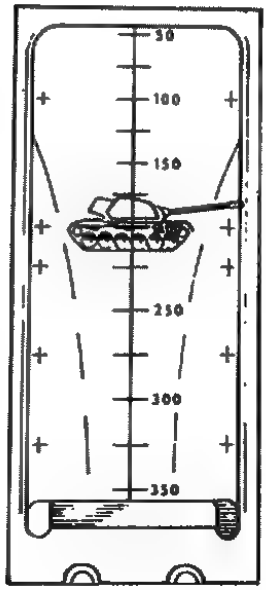
FRONT SIGHT:

A TRANSPARENT OLASTIC PLATE WITH RANGES AND LEAD POINTS INSCRIBED ON IT.

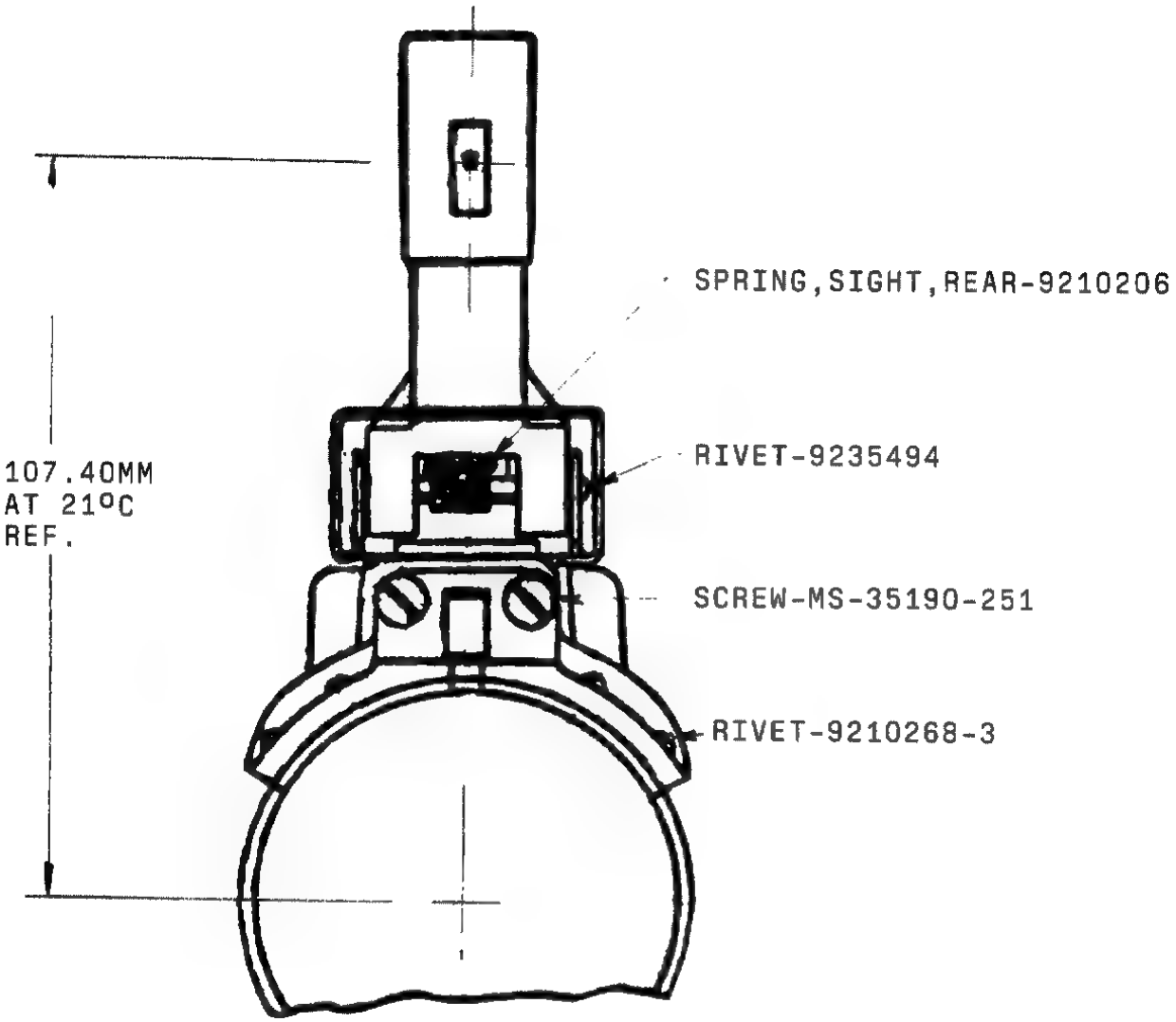
REAR SIGHT:

NON-TRANSPARENT PLASIC PLATE WITH PEEP HOLE;SIGHT FLIPS UP WHEN LAUNCHER TUBE IS EXTENDED.



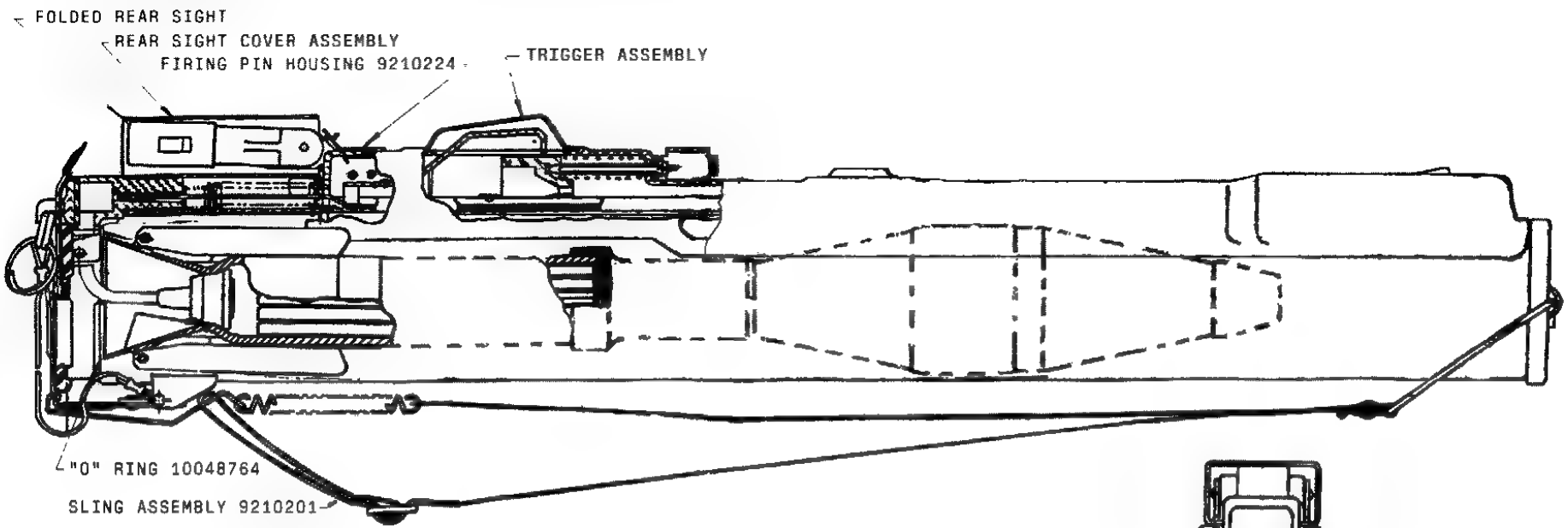


A VIEW OF A TANK TARGET AT 200 METERS



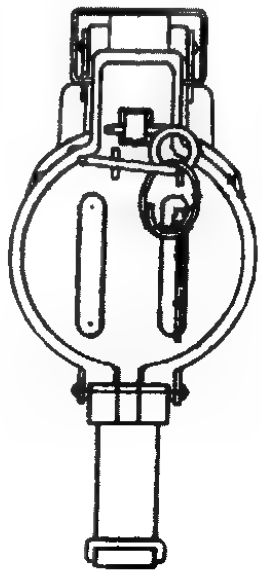
LAUNCHER,ROCKET 66MM M72A2-9210200
DETAIL OF REAR SIGHT

DUE TO THE VARIATIONS IN ASSEMBLY TEMPERATURE,SIGHT SETTING MAY VARY BY DECREASING 0.08MM PER DEGREE C INCREASE OR BY INCREASING 0.08MM PER DEGREE C DECREASE.



NOTE: MAX LENGTH CLOSED = 653.5MM

LAUNCHER,ROCKET 66MM M72A1-9210200



REAR VIEW OF LAUNCHER

-AFTER ROCKET HAS BEEN PLACED INTO POSITION,TWIST END OF ROUND LOCK INTO POSITION TO HOLD AGAINST LAUNCHER.

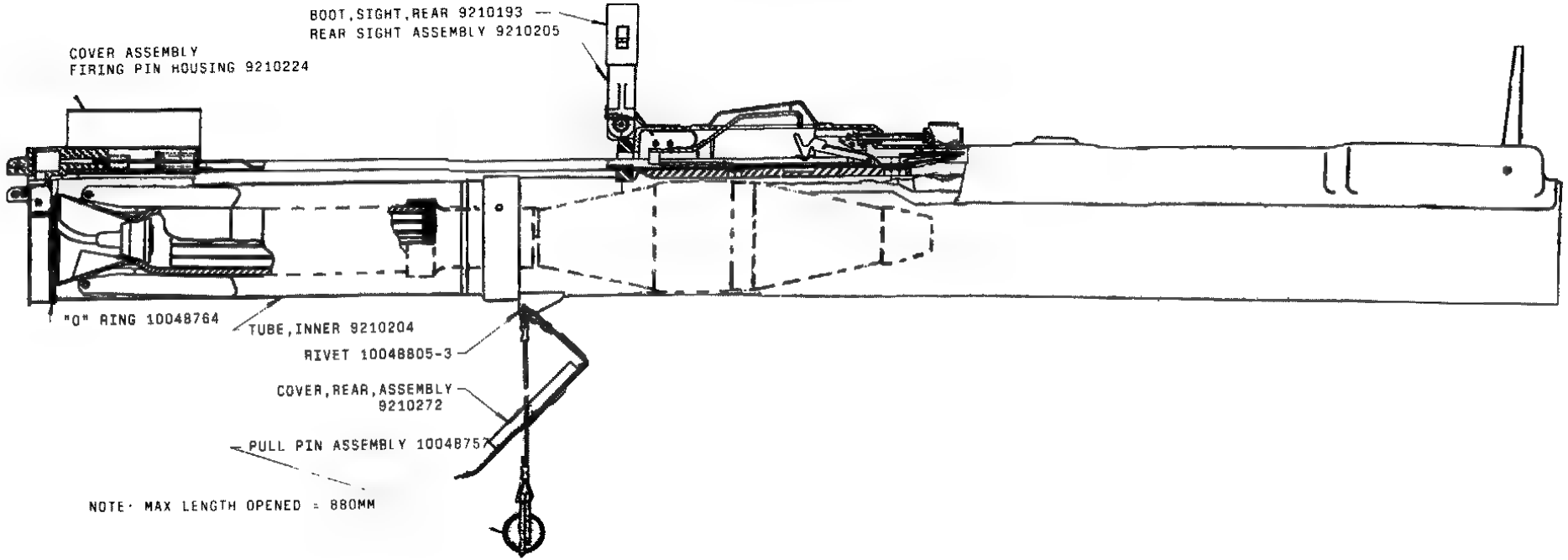
-REMOVE IGNITER SAFETY CAP PRIOR TO ASSEMBLY OF INTEGRAL IGNITER INTO FIRING PIN HOUSING.

-THE FORCE TO FINAL ASSEMBLE THE ROCKET INTO THE LAUNCHER SHALL NOT EXCEED 10 POUNDS.

-CRACKS IN TRIGGER HOUSING MAY BE REPAIRED USING EPOXY ADHESIVE

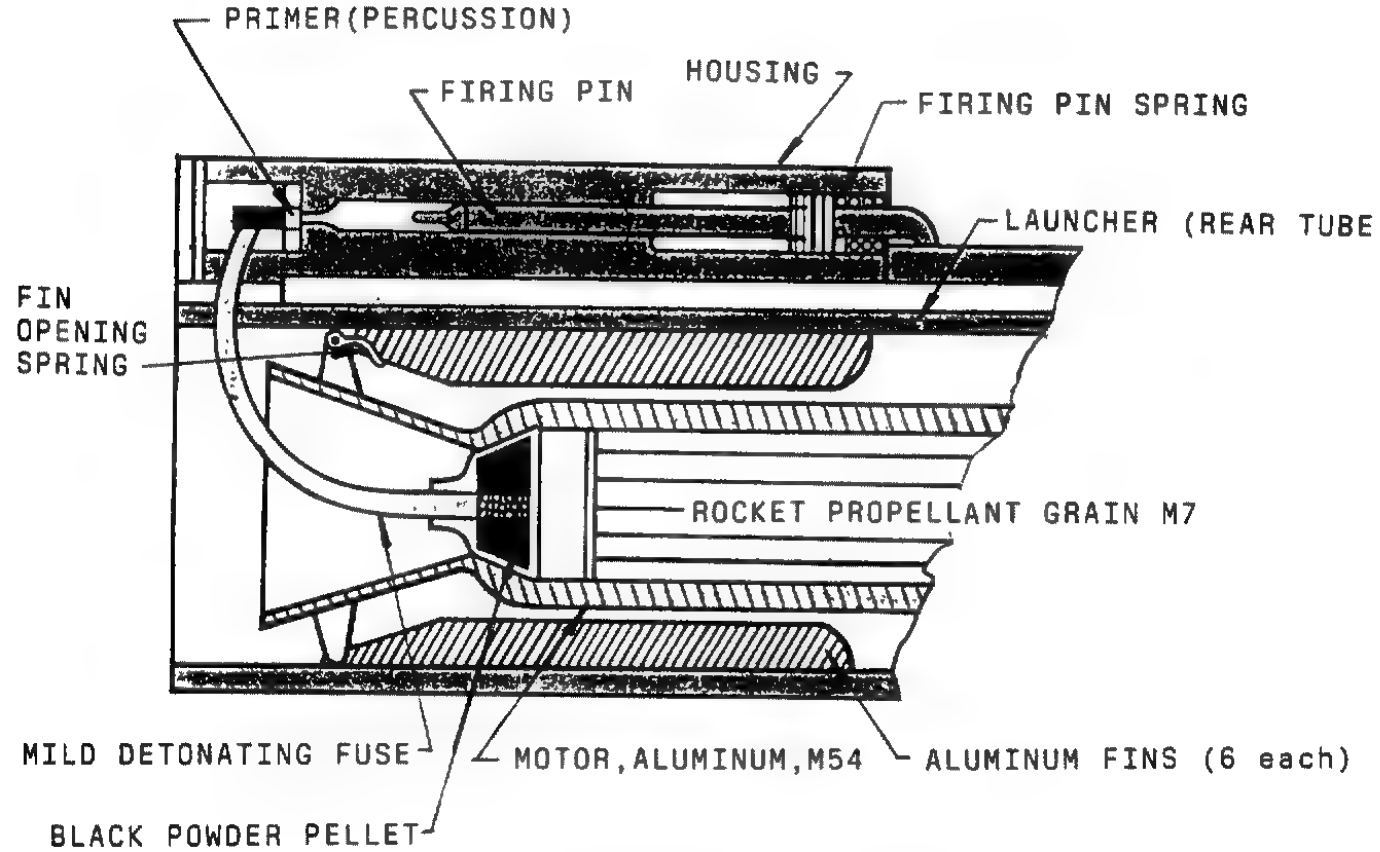
-AFTER ASSEMBLY THE UNIT IS INSPECTED AND ALL EXPOSED SURFACES ARE WATERPROOFED WITH SILICONE ADHESIVE SEALANT

-ALL PAINTED SURFACES ARE RETOUCHED WITH OLIVE DRAB PAINT

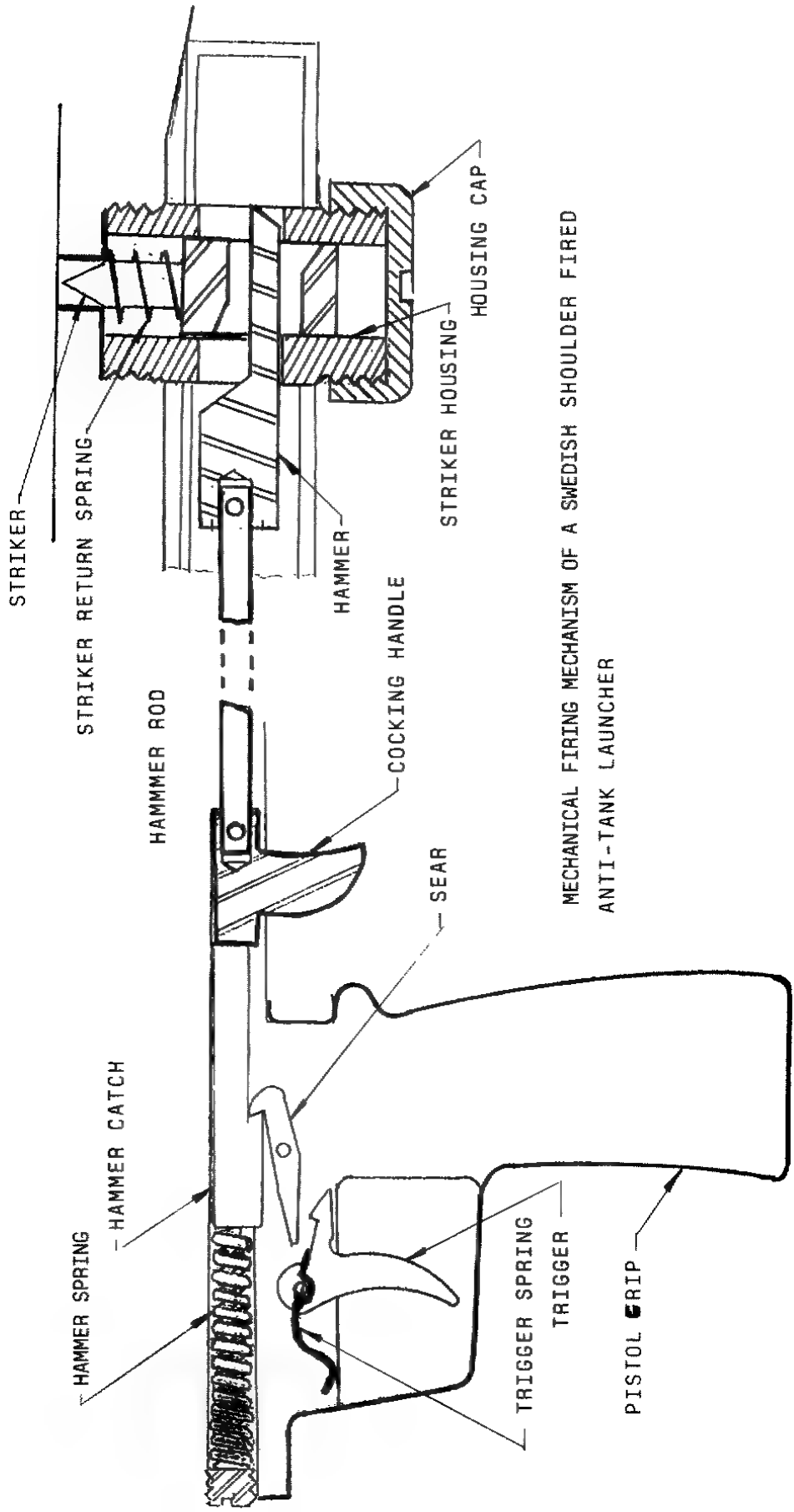


M72A2 ROCKET,66MM, ASSEMBLY 9210200

It is interesting to note that while the original Bazooka used an electrical ignition system, the US Army M-72A1 and M-72A2 (LAW) 66 MM HEAT rocket uses a mechanical ignition system illustrated below.



SCHEMATIC OF A MECHANICAL IGNITION SYSTEM
USED ON THE ROCKET,HEAT,66MM, M72A2 (LAW)

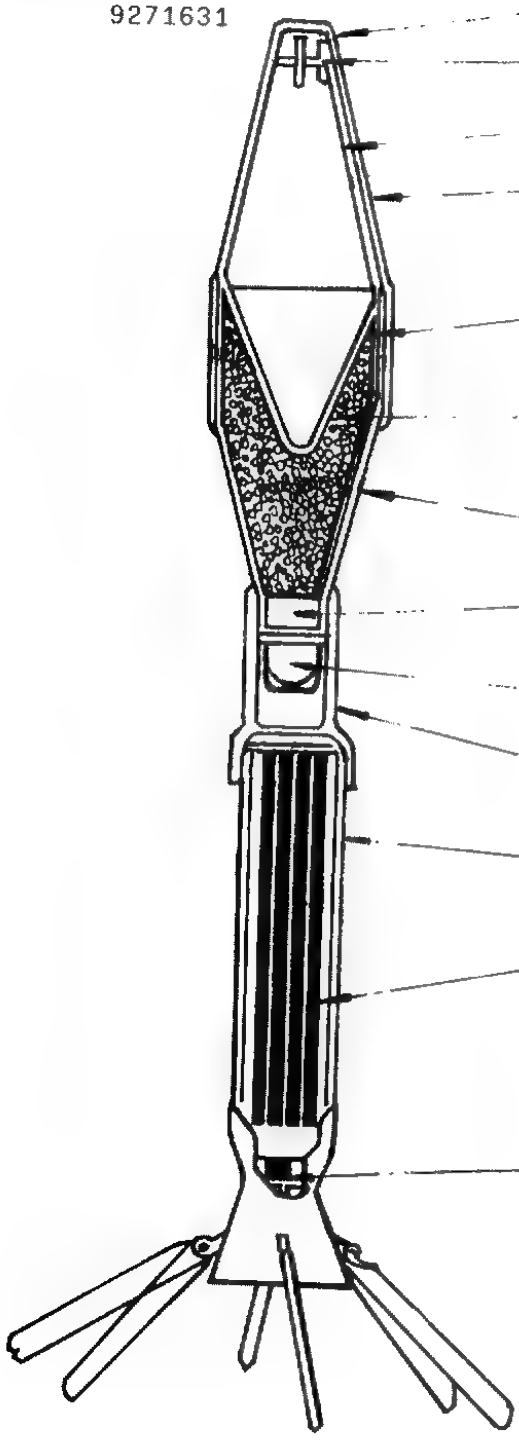

MECHANICAL FIRING MECHANISM OF A SWEDISH SHOULDER FIRED
ANTI-TANK LAUNCHER
STRIKER
STRIKER RETURN SPRING
HAMMMER ROD
HAMMER
STRIKER HOUSING
HOUSING CAP
COCKING HANDLE
SEAR
HAMMER CATCH
HAMMER SPRING
TRIGGER SPRING
TRIGGER
PISTOL GRIP

The LAW

M-72A2 LAW ROCKET

Specification
MIL-R-40431
Drwg.# 9210200
9244054
9271631

length, cm 51
weight, gram 1050
muzzle velocity, m/sec 145



NOSE CAP

TERMINALS

LEAD WIRE

STAND-OFF SHIELD
(shrink-fitted onto body)

LINER

HIGH EXPLOSIVE CHARGE Drwg.# 9220248
(305 gram of Octol)

BODY Drwg.# 9220011

BOOSTER
(Tetryl)

FUZE, M412 A1 Drwg.#9223224

FUZE CLOSURE
(cold formed aluminum alloy)

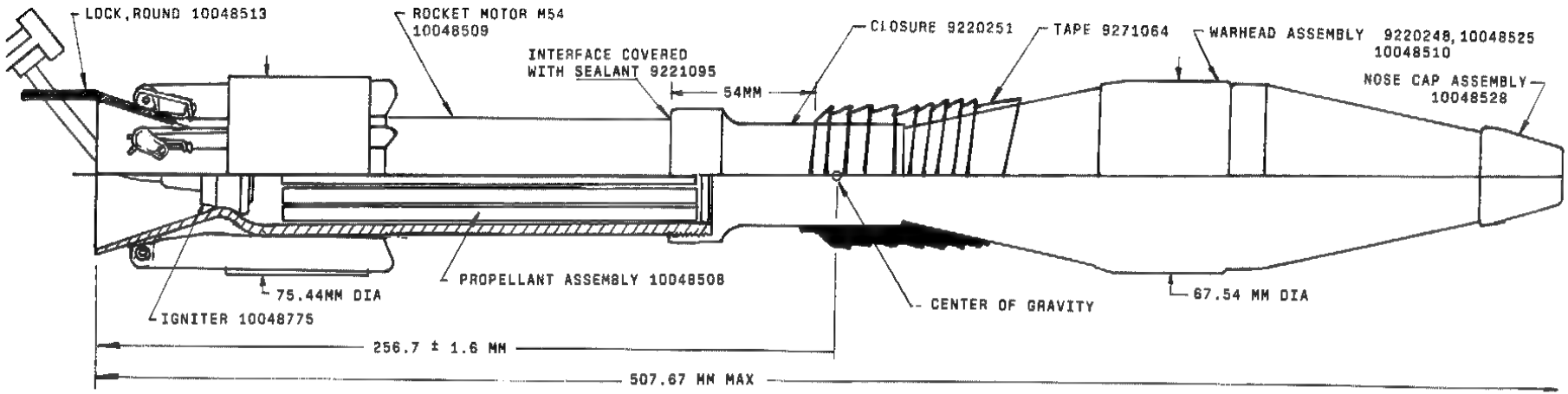
MOTOR, M- 54 Drwg.#10048519
(extruded from aluminum alloy *)

ROCKET GRAIN, M-7 Drwg.#10048508
(designed for low-pressure burning
yet allowing in-launcher burnout)
19 sticks
58 gram total

INGNITER, M56 Drwg.#10048775
(black powder pellet connected to
MDF **)

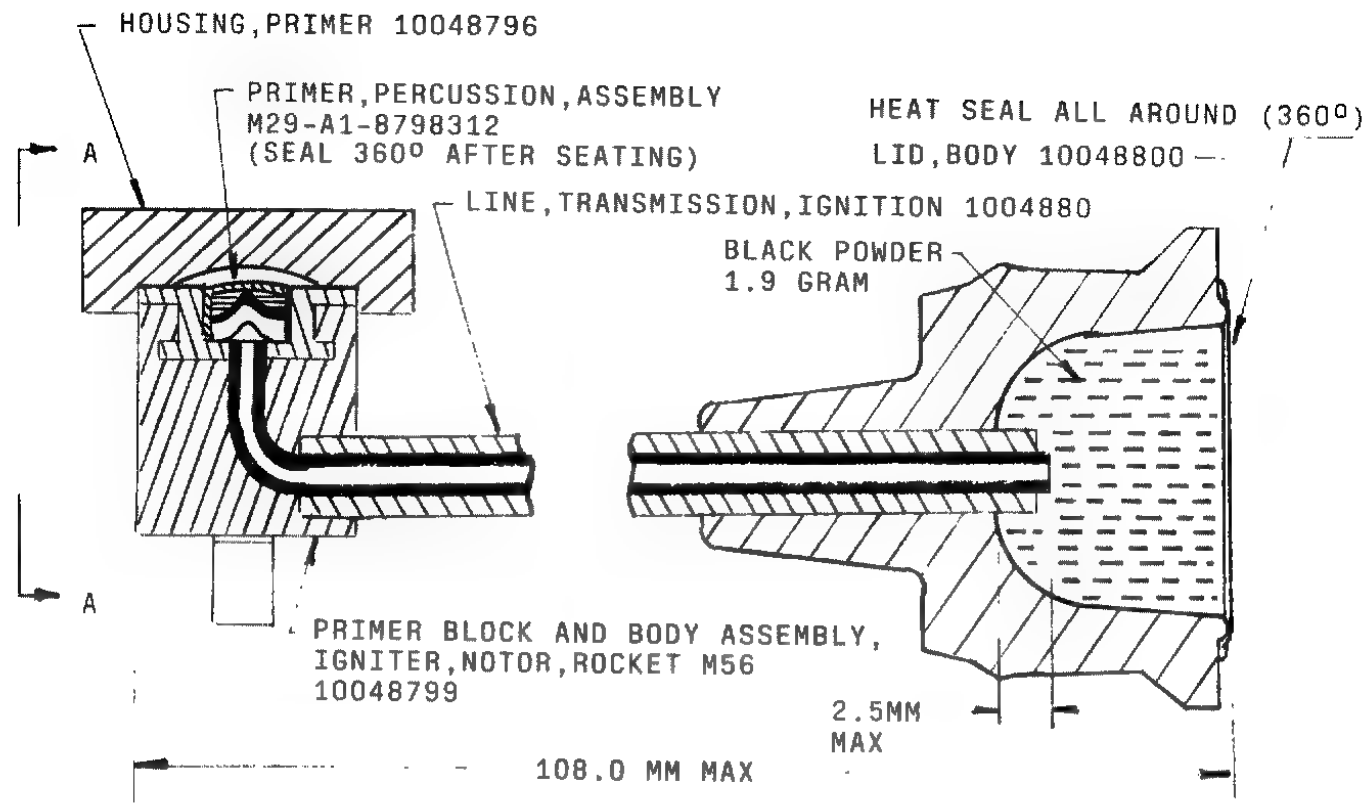
*) tensile strength ,PSI min. 85,000
yield strength ,PSI min. 80,000

**) DuPont "Mild Detonating Fuse"

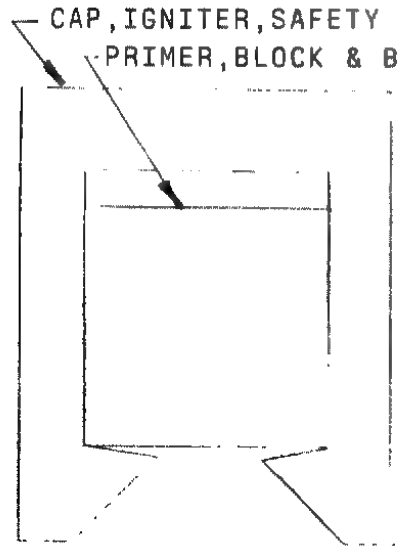


66MM ROCKET,HE,M18A1
9235663
9271631

NOTE: ASSEMBLED WEIGHT
1035± 5 GRAM



IGNITER, LOADING ASSEMBLY 10048775



VIEW A-A

NOTES:

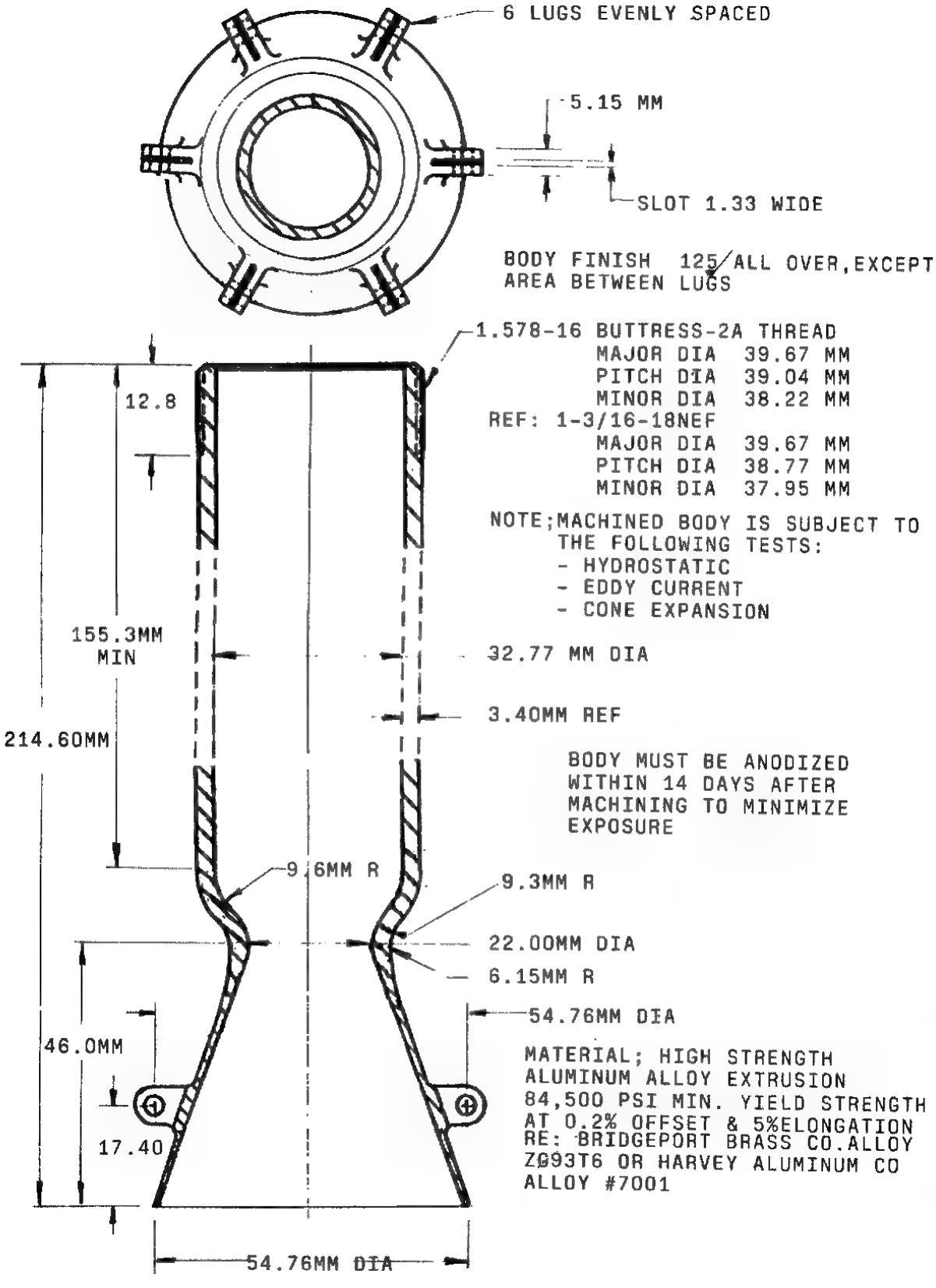
-PRIMER TO BE FLUSH OR BELOW SEATING SURFACE.

-PRIMER SEATING FORCE 80+10 KG

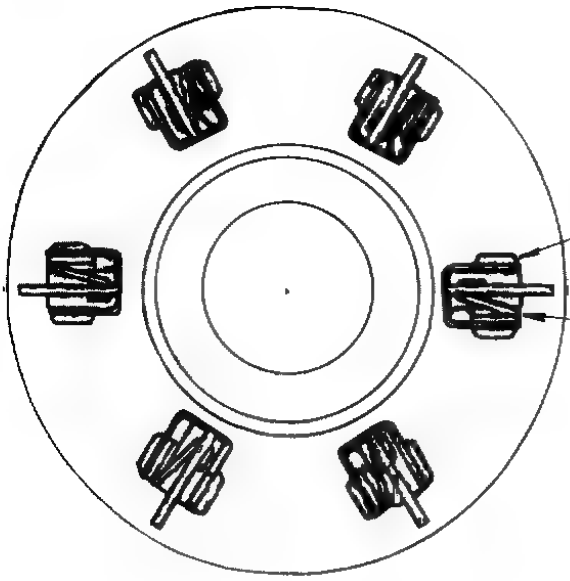
-SAFETY CAP IS A TEMPORARY PROTECTIVE ITEM USED DURING FINAL LAP.

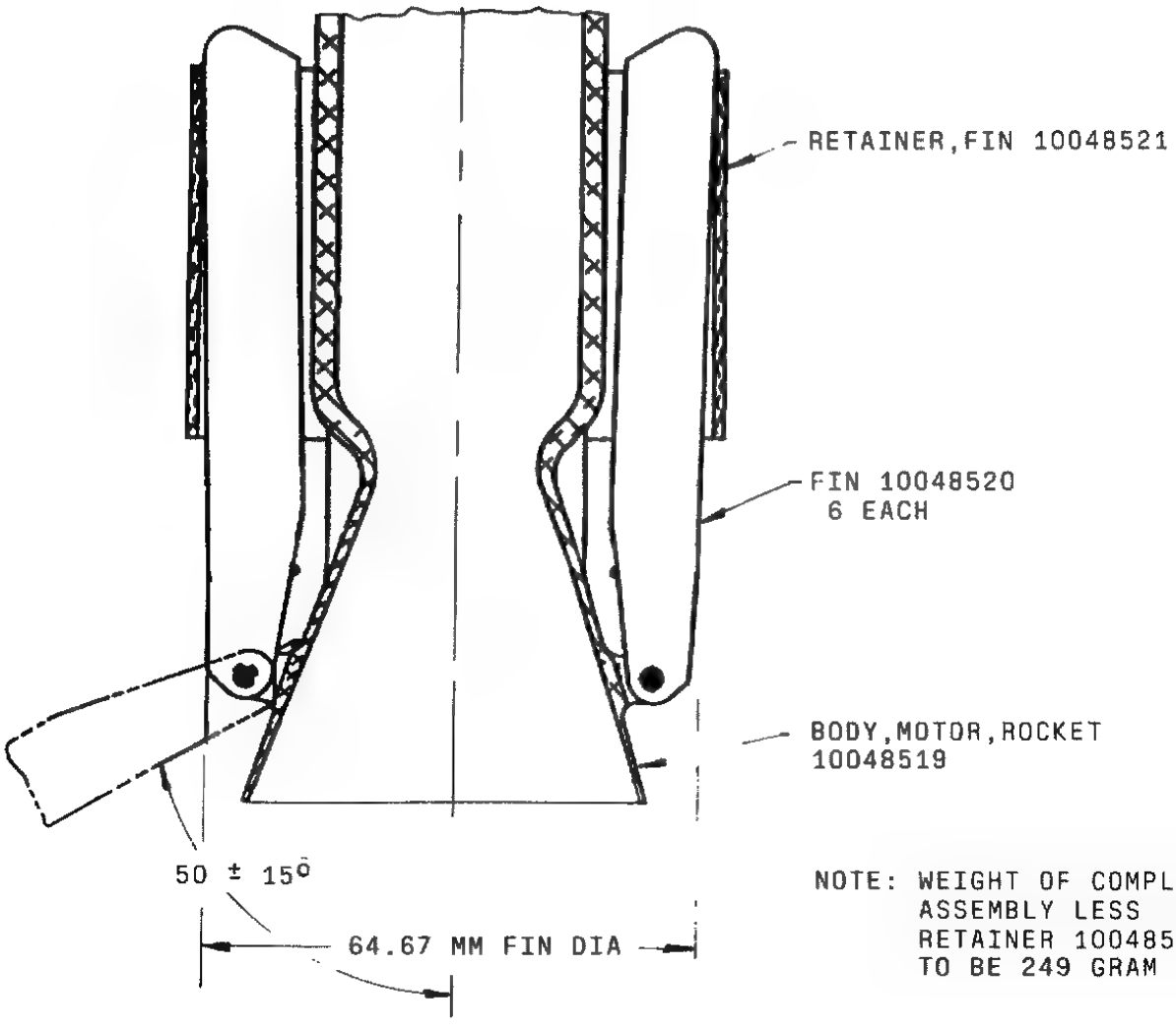
-FOR HEAT SEALING USE TINTED PHENOL-FORMALDEHYDE VARNISH MIL-V-13750,TYPE I,GRADE A OR B, COLOR OPTIONAL

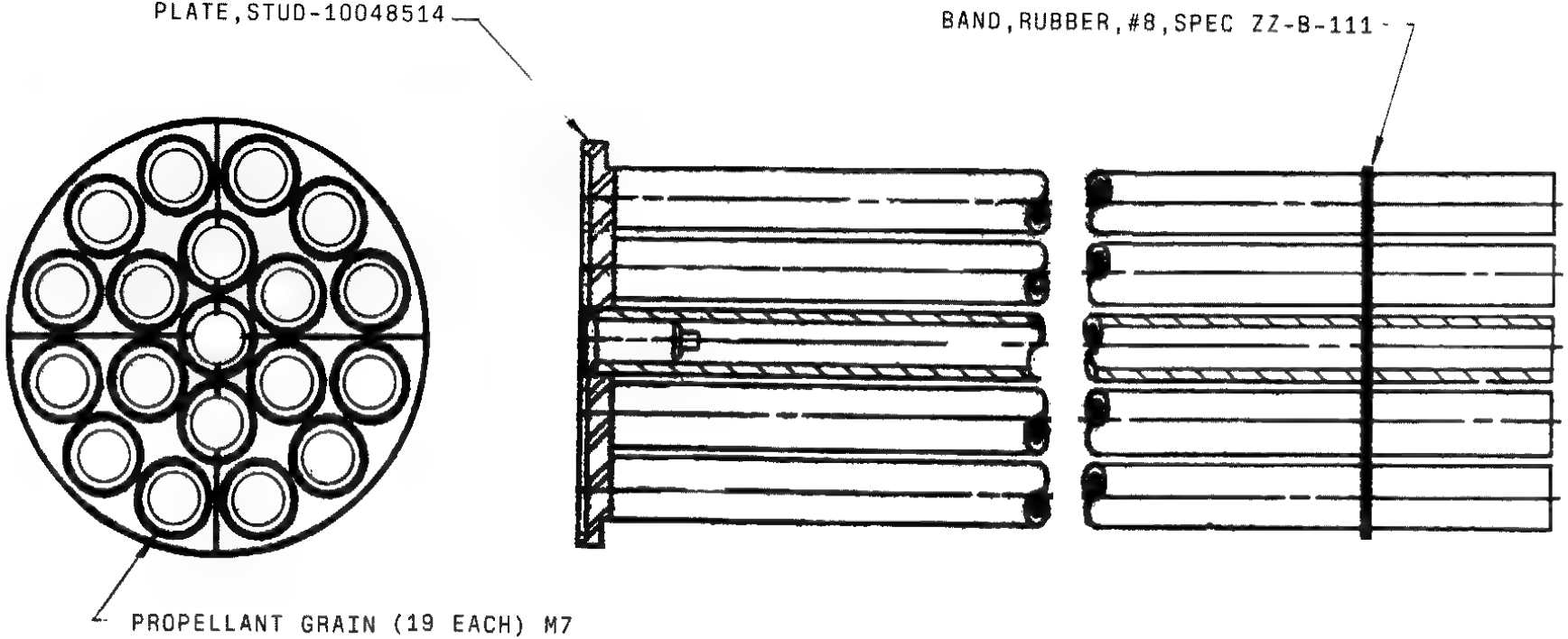
-BLACK POWDER SPEC MIL-P-223,CLASS 5



BODY,MOTOR,ROCKET M54 10048519


EYELET 10048572
6 EACH
SPRING,FIN 10048518
6 EACH

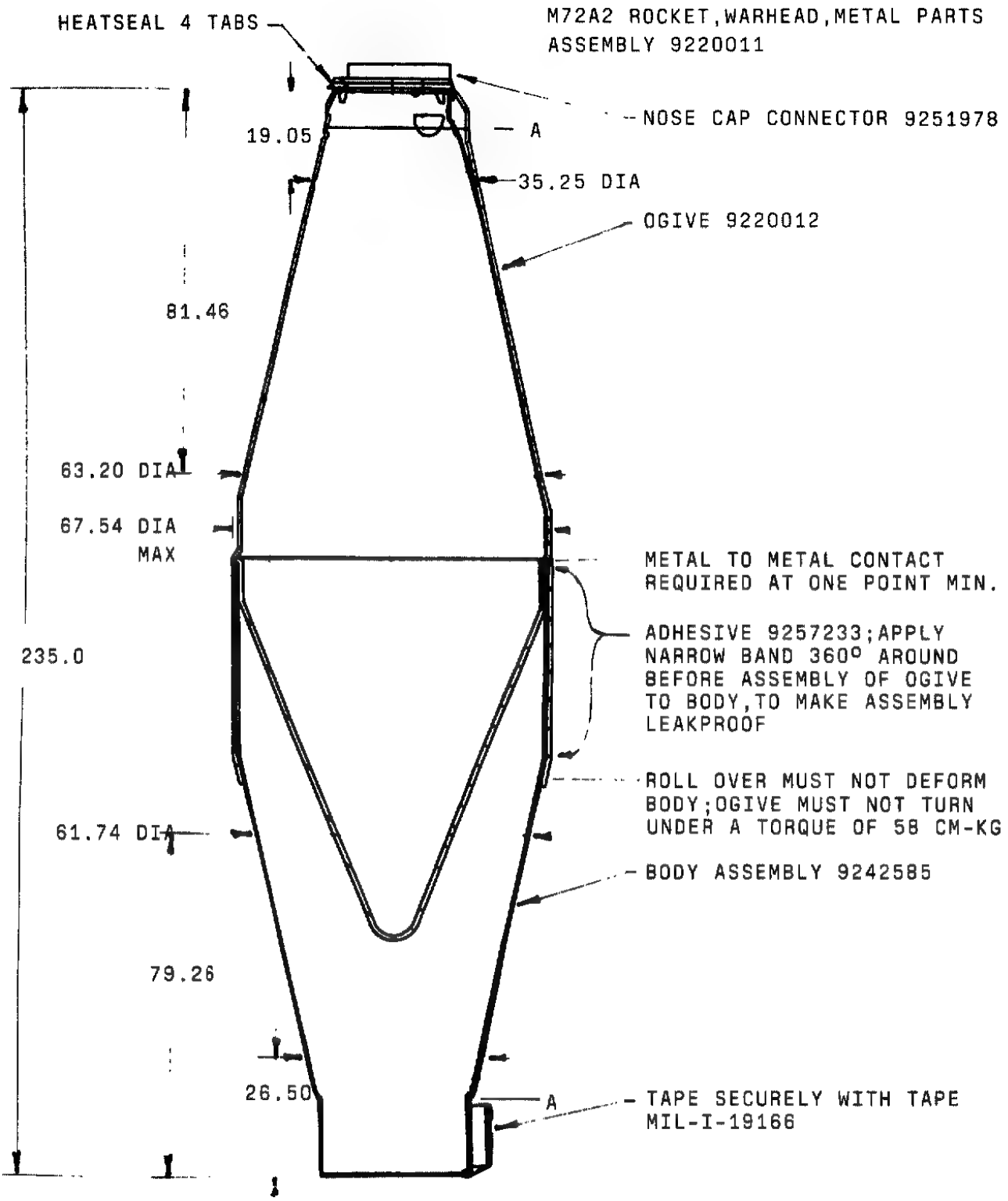

RETAINER,FIN 10048521
FIN 10048520
6 EACH
BODY,MOTOR,ROCKET
10048519
50 ± 15°
64.67 MM FIN DIA
NOTE: WEIGHT OF COMPLETE
ASSEMBLY LESS
RETAINER 10048521
TO BE 249 GRAM
MOTOR,ROCKET M54 - 10048509



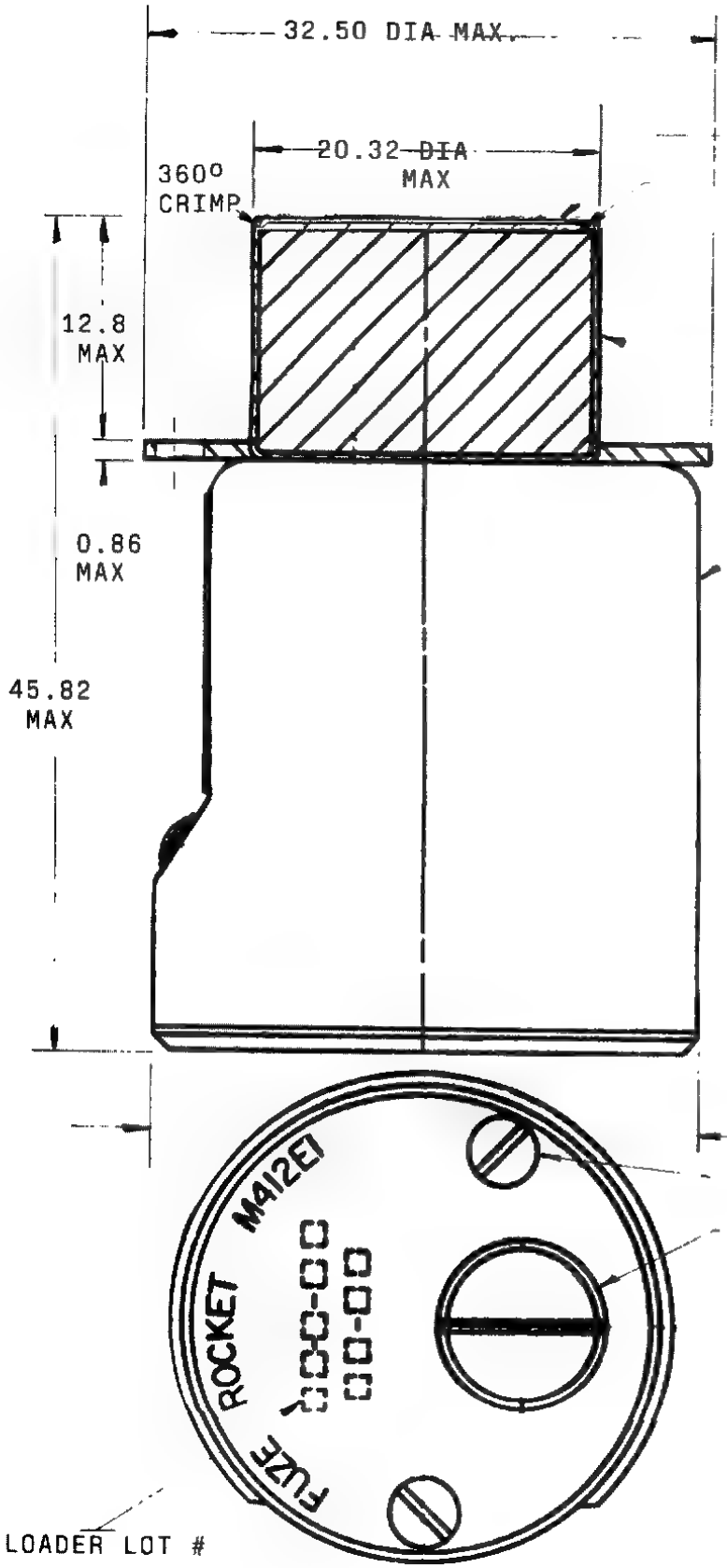
M72A2 ROCKET MOTOR M54

STUD AND PROPELLANT ASSEMBLY 10048515

NOTE: REMOVE RUBBER BAND PRIOR TO ASSEMBLY INTO MOTOR BODY

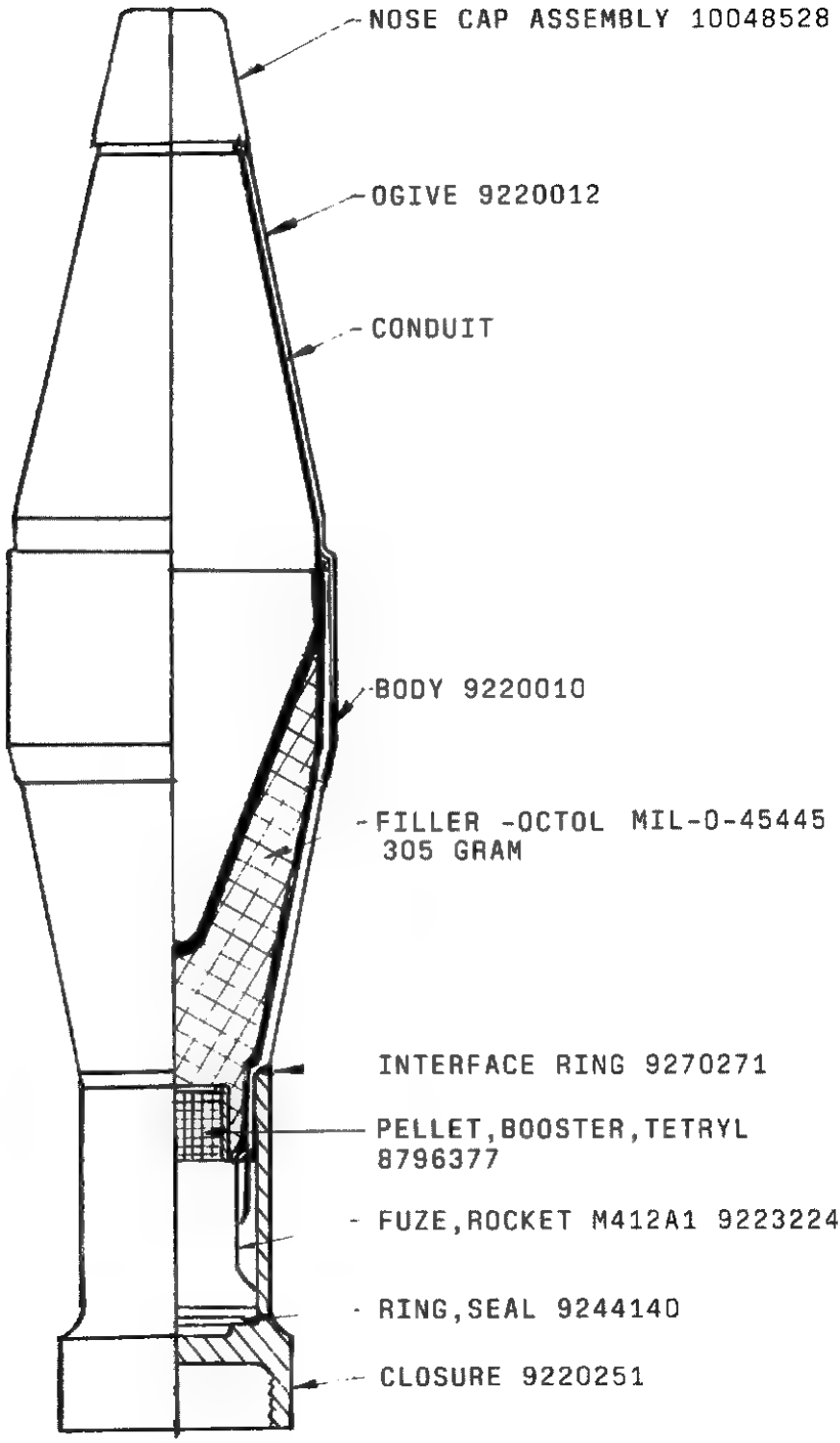


NOTES: - AFTER ASSEMBLY - PAINT BLACK BETWEEN POINTS A-A
ASSEMBLE CABLE 9251980 TO WARHEAD ASSEMBLY
PERFORM ELECTRICAL CHECK AFTER COMPLETE ASSEMBLY
- ALL DIMENSIONS IN MILLIMETERS



NOTE: UNCRIMPED LENGTH IS 48.00
ALL DIMENSIONS IN MILLIMETERS

M72A2 ROCKET,HEAT,WARHEAD,ASSEMBLY 9220248 & 10048525



Typical warhead assembly procedure (M72A2 HEAT warhead)

1 - Seat and secure liner onto body
2 - Insert conduit into ogive (stand-off shield)
3 - Apply adhesive to upper part of body
4 - Pull conduit through body
5 - Crimp ogive onto body
6 - Check joint strength
7 - Preheat warhead
8 - Place riser funnel into bottom of body
9 - Pour hot explosive filler melt into the warhead
10 - Vibrate warhead during pouring step
11 - Remove riser funnel; the detonator cavity should be 20.8 mm dia. by 14.0mm deep.
12 - Allow filled warhead to cool
13 - Seat interface ring
14 - Seat fuze
15 - Connect conduit to fuze,be sure the conduit contact ends are free of explosive and foreign matter
16 - Make electric check of conduit
17 - Apply adhesive sealant on complete circumference of respective surfaces of ogive and nose cap prior to assembling these components
18 - Apply adhesive to bonding surfaces of body neck and closure as follows:

a - Clean bonding surfaces with solvent cleaner
b - Apply Locktite primer T (spray or brush) to bonding surfaces
c - Apply a continuous (360°) bead of Locktite 308, about 5mm wide around the exterior of body neck,about 5 mm away from the open end. Brush the adhesive to cover evenly the entire neck.
d - Apply a continuous (360°) bead of Locktite 308 about 3mm wide around the inside bonding surface of the closure, about 5mm from the open end.
e - Assemble closure to warhead body within one (1) minute after adhesive has been applied, using a press force of 90 Kg max.
f - Keep the assembled joint under 90 ± 10 Kg force for 15 minutes. There should be no gap visible between the interference ring and the closure.
g - Allow 45 minutes for the adhesive to cure without disturbing.
h - Apply 90 ± 10 Kg pull test after curing
I - Apply adhesive sealant to ogive and nose cap mating surfaces before assembling them.

Additional precautions:

-Primed parts must be used within 8 hours or be re-primed.
- Warhead and fuze must be kept aligned and not rotated during assembly into closure.

-Closure has to pass ultrasonic physical defect test prior to assembly with warhead.
-The primer and adhesive material must be stored and handled in non-corrosive, glass or polyethylene containers only.
Storage temperature control 5 - 32 °C Materials to be no more than 90 days old.

Assembly Procedure for the 66 MM Rocket MI8AI

After the warhead-fuze-closure assembly is completed, the rocket is assembled in the following manner.

1 - The igniter is seated into the motor nozzle.
a- A bead of sealant MIL-A-46106, about 5 mm wide by about 3mm high is applied around the circumference between the major and retaining flanges.
b- The igniter is then forced into the nozzle and the motor is ready for loading.

2 - The rubber band is removed from the propellant assembly and the propellant is inserted into the motor.

3 - The mating surfaces of the motor and the closure are:
a - Sprayed with anaerobic primer, grade T and allowed a minimum of 5 minutes to dry
b- Then 3-4 drops of sealant grade AV or AVV (MIL-S-22473) are applied to the threads and the motor is screwed into the closure FINGER TIGHT.
c - The sealant is then allowed to set six (6) hours minimum.

Note: the lot samples tested should require a torque of 115 cm-Kg to disassemble.

4 - The motor-closure joint is then closed with a 360° bead of sealant 9221095. The closure holes are also covered with a 5 x 5 mm piece of tape L-T-80 (aluminum foiled back)

5 - Paint and protective finish are removed from the area of closure and warhead which is to be wrapped in tape. The paint should be removed 2 hours prior to the wrapping operation.

6 - The de-painted surfaces are cleaned with acetone or perchloroethylene by wiping in the direction of the nose cap, 10 minutes prior to the tape wrapping.

7 - Tape 9271064 is applied in three (3) continuous layers with a 100% overlap.This operation must be done at temperature no less than 16°C to assure positive adhesion of tape to the surfaces.

8 - Over the tape 9271064 is laid another two continuous layers of vinyl tape MIL-I-7798, forward and return,with two wraps at each end of the impregnated tape. Sufficient tension is to be maintained on the vinyl tape to compact, but not disturb or slide the tape 9271064. A 50% overlap of the vinyl tape must be kept. After completion of vinyl tape wrapping,wipe off excess epoxy exuding from the vinyl overlap.

9 - The vinyl tape is cured at 40 ± 10°C for 16 hours before the next assembly
10 - The assembled rocket is then re-touched with appropriate paint where necessary.

After the complete assembly the projectile is checked for the correct weight. Weight may be added to the approximate center of gravity with a pressure sensitive lead foil tape HH-T-0029 (about 38 mm wide). The final projectile is marked with the loader lot number, month and year of loading, on the warhead in accordance with the product specifications.

LIST OF SPECIFICATIONS, STANDARDS AND DRAWINGS OF THE DEPARTMENT OF DEFENSE; PERTAINING TO THE M72 LAW.

MIL-STD-8A			
MIL-STD-171	COLORS	20.1	# 30117-BROWN # 34087-OLIVE DRAB # 37038-BLACK

SPECIFICATIONS:

MIL-A- 2550	AMMUNITION
A-46106	ADHESIVE,SEALANT
A-52194	ADHESIVE,EPOXY
F-50415	FUZE
I- 7798	TAPE
I-19166	TAPE
I-60008	IGNITER
L-60385	LAUNCHER
M-50003	MOTOR
O-45445	OCTOL
P- 223	POWDER,BLACK
R-50431	ROCKET
R-60011	ROCKET
S- 8660	SEALING COMPOUND
S-22473	SEALING COMPOUND
T- 339	TETRYL
V-13750	VARNISH
W-50275	WARHEAD
L-T- 80	TAPE,PRESSURE SENSITIVE
HH-T- 0029	TAPE,LEAD
UU-T- 93	TAPE
TT-I- 556	INK
TT-I- 558	INK,#33538,YELLOW
TT-I- 559	INK

DRAWINGS #

8796377	PELLET,BOOSTER
8796378	DISC,CUP
8796379	WASHER
8796384	PLUG,BASE
8796385	SCREW,BASE

DRAWINGS #	
7898312	PRIMER
9210156	SEAL,HOUSING
9210169	FIRING PIN HOUSING
9210170	DETENT
9210184	SEAL,SAFETY
9210191	BOOT,DETENT
9210192	BOOT,TRIGGER
9210193	BOOT,SIGHT,REAR
9210200	ASSEMBLY
9210201	SLING ASSEMBLY
9210204	TUBE,INNER
9210205	REAR SIGHT ASSEMBLY
9210206	SPRING,SIGHT,REAR
9210215	ADHESIVE
9210224	COVER ASSEMBLY,F.P.HOUSING
9210268	RIVET
9210272	COVER,REAR,ASSEMBLY
9218009	CONNECTOR,CABLE
9220010	BODY
9220011	WARHEAD METAL PARTS ASSEMBLY
9220012	OGIVE
9220247	BODY,LOADING ASSEMBLY
9220248	WARHEAD ASSEMBLY
9220251	CLOSURE
9221092	SEALANT
9221095	SEALANT
9223224	FUZE M412A1
9235494	RIVET
9235663	ROCKET ASSEMBLY
9242585	BODY ASSEMBLY
9244054	ASSEMBLY
9244140	RING,SEAL
9251980	CABLE ASSEMBLY
9257233	ADHESIVE
9270271	INTERFACE RING
9271064	TAPE,IMPREGNATED
9271631	ROCKET ASSEMBLY
10048225	SAFETY CAP IGNITER
10048503	ROCKET ASSEMBLY
10048508	PROPELLANT ASSEMBLY
10048509	MOTOR M54
10048510	WARHEAD
10048513	LOCK,ROUND
10048519	LOCK,BODY
10048520	FINS
10048525	BODY LOADING
10048528	NOSE CAP ASSEMBLY
10048538	BODY ASSEMBLY
10048542	OGIVE
10048569	CLOSURE
10048757	PULL PIN ASSEMBLY
10048764	"O" RING
10048775	IGNITER
10048788	FUZE M412
10048796	PRIMER HOUSING
10048799	MOTOR M56
10048805	RIVET
MS35190-251	SCREW

MILITARY SPECIFICATION MIL-R-14741

ROCKET, HE, 66 MILLIMETER, ANTITANK M72AI LOADING, ASSEMBLING AND PACKING

1. SCOPE

1.1 This specification covers special requirements, not normally required by the drawings and the quality assurance provisions for the loading, assembling and packing for one type of antitank complete round designated as Rocket, HE, *66* Millimeter, Antitank, M72AI.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids, form a part of this specification to the extent specified herein:

SPECIFICATIONS

MILITARY

MIL-A-2550	- Ammunition and Special Weapons: - General Specification For.
MIL-S-I2560	- Steel, Armor Plate, Combat Vehicle Type.
MIL-I-5607	- Inspection Equipment, Supply and Maintenance Of.

STANDARDS

MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-109	- Quality Assurance Terms and Definitions.
MIL-STD-810	- Environmental Test Methods.
MIL-STD-1167	- Ammunition Data Cards
MIL-STD-1235	- Single and Multilevel Continuous Sampling Procedures and Tables for Inspection by Attributes

Appendix

The concept of providing an individual infantryman with a suitable weapon to defeat an armoured vehicle gave birth to a similar idea. Why not design and build a weapon which will enable the same infantryman to shoot down a low-flying aircraft? And so was born the "Fliegerfaust" (Pilot fist).

The first "Fliegerfaust" was a cluster of nine tube launchers, each containing a standard 20MM HE shell with a rocket motor attached to it. The rockets were specifically designed to duplicate the spin activation of the fuze when fired through a rifled barrel. The rockets were fired electrically in two salvos. First salvo of five rockets was followed a fraction of a second later by the second salvo of four rockets. A time delay mechanism was used for this purpose. This firing method produced not only a shotgun-like pattern, but also gave a shell-firing effect and hit probability. The weapon was reloaded by another nine rockets inserted in a clip, similar to the speed loading of a revolver. The system was ready for production in March 1945, much too late for any field use.

However the idea did not die. With the development of better guidance systems and a general improvement of the rocket motors, the multi-projectile idea was abandoned. Instead a true "Anti-aircraft bazooka" was born. The best examples currently in use are the "Blowpipe" (British), SA7 (Russian) and Stinger (USA). The bazooka did not make the tank disappear from the battlefield, neither does the Stinger eliminate the aircraft. But it surely caused its wings and missiles to fly higher and at a respectable distance from the infantryman.

HAND-HELD SHOULDER-FIRED ANTI-AIRCRAFT INFANTRY WEAPONS
("FLIEGERFAUST")

MODEL	BLOWPIPE	SA7	STINGER
YEAR OF INTRODUCTION (approximate)	1975	1965	1977
WEAPON WEIGHT: ready to fire, Kg	21	9.5	13.5
MISSILE WEIGHT, Kg	14		
WEAPON LENGTH, cm	140	130	153
RANGE,MAXIMUM, m	3000	3000	4000
MAX. EFFECTIVE ALTITUDE, m	1500	900	1500
MISSILE DIAMETER, mm	76	70	70
ROCKET MOTOR TYPE	2 stage	3 stage	2 stage
AIMING METHOD	electro-optical	open sight	optical
GUIDANCE METHOD	auto-collecting	heat-seeking	IR passive homing

Notes: 1 - Due to control problems,the Blowpipe has been released to air defense artillery units only.

2 - Data above varies between sources due to model modification.

FRONTAL ARMOR OF WORLD WAR II TANKS

MODEL		ARMOR THICKNESS millimeters
US Mk3 (Stuart)		43
US Mk4 (Sherman)		80
US M26 (Pershing)		145
British Matilda		80
British Comet		100
German MkIV		80
German MkV (Panther)	hull	80
	turret	110
German MkVI (Tiger)		100
Russian T-34		65

Note: The above dimensions do not consider the slope angle of the armor plate.

Bibliography

Anon — AMCP706-177

Anon — TM9-294 (1946)

Anon — TM9-1055-201-12 (1968 and 35) (1964)

Anon — Handbook for pre-military training (Utshebnoe posobie po natchalnoi voennoi podgotovke) (1968)

Anon — Illustrated Science & Invention Encyclopedia, V.2, H. S. Stuttman Co., Inc. Publishers, NYC 1974

Author's personal notes

Chant, C. — How Weapons Work, Marshall Cavendish Publisher Ltd., London 1965

Goad, K. J. W., et al — Ammunition, Brassey's Publishers Ltd. Elmsford, NY 1982

Myatt, F. — Modern Small Arms, Crescent Books, NY 1978

Owen, J. I. H. — Infantry Weapons of the World 1950-1975, Bonanza Books--Crown Publishers, Inc. 1975

Notes

Other Books Available From Desert Publications

001	Firearms Silencers Volume 1	$9.95
003	The Silencer Cookbook	$9.95
004	Select Fire Uzi Modification Manual	$9.95
005	Expedient Hand Grenades	$16.95
007	007 Travel Kit, The	$8.00
008	Law Enforcement Guide to Firearms Silencer	$8.95
009	Springfield Rifle, The	$11.95
010	Full Auto Vol 3 MAC-10 Mod Manual	$9.95
012	Fighting Garand, The	$11.95
013	M1 Carbine Owners Manual	$9.95
014	Ruger Carbine Cookbook	$11.95
015	M-14 Rifle, The	$9.95
016	AR-15, M16 and M16A1 5.56mm Rifles	$11.95
017	Shotguns	$11.95
019	AR15 A2/M16A2 Assault Rifle	$8.95
022	Full Auto Vol 7 Bingham AK-22	$9.95
027	Full Auto Vol 4 Thompson SMG	$9.95
030	STANAG Mil-Talk	$12.95
031	Thompson Submachine Guns	$13.95
033	H&R Reising Submachine Gun Manual	$12.95
035	How to Build Silencers	$6.95
036	Full Auto Vol 2 Uzi Mod Manual	$9.95
049	Firearm Silencers Vol 3	$13.95
050	Firearm Silencers Vol 2	$19.95
054	Company Officers HB of Ger. Army	$11.95
056	German Infantry Weapons Vol 1	$14.95
058	Survival Armory	$27.95
060	Survival Gunsmithing	$9.95
061	FullAuto Vol 1 Ar-15 Mod Manual	$8.95
064	HK Assault Rifle Systems	$27.95
065	SKS Type of Carbines, The	$16.95
066	Private Weaponeer, The	$9.95
067	Rough Riders, The	$24.95
068	Lasers & Night Vision Devices	$29.95
069	Ruger P-85 Family of Handguns	$14.95
071	Dirty Fighting	$11.95
072	Live to Spend It	$29.95
073	Military Ground Rappelling Techniques	$11.95
074	Smith & Wesson Autos	$27.95
080	German MG-34 Machinegun Manual	$9.95
081	Crossbows/ From 35 Years With the Weapon	$11.95
082	Op. Man. 7.62mm M24 Sniper Weapon	$7.95
083	USMC AR-15/M-16 A2 Manual	$16.95
084	Urban Combat	$21.95
085	Caching Techniques of U.S. Army Special Forces	$9.95
086	US Marine Corps Essential Subjects	$16.95
087	The Lil M-1, The .30 Cal. M-1 Carbine	$14.95
088	Concealed Carry Made Easy	$14.95
089	Apocalypse Tomorrow	$17.95
090	M14 and M14A1Rifles and Rifle Marksmanship	$16.95
091	Crossbow As a Modern Weapon	$11.95
092	MP40 Machinegun	$11.95
093	Map Reading and Land Navigation	$19.95
094	U. S. Marine Corps Scout/Sniper Training Manual	$16.95
095	Clear Your Record & Own a Gun	$14.95
096	Sig Handguns	$16.95
097	Poor Man's Nuclear Bomb	$19.95
098	Poor Man's Sniper Rifle	$14.95
100	Submachine Gun Designers Handbook	$16.95
101	Lock Picking Simplified	$8.50
102	Combination Lock Principles	$8.95
103	How to Fit Keys by Impressioning	$7.95
104	Keys To Understanding Tubular Locks	$9.95
105	Techniques of Safe & Vault Manipulation	$9.95
106	Lockout -Techniques of Forced Entr	$11.95
107	Bugs Electronic Surveillance	$11.95
110	Improvised Weapons of Amer. Undergrnd	$10.00
111	Training Handbook of the American Underground	$10.00
114	FullAuto Vol 8 M14A1 & Mini 14	$9.95
116	Handbook Bomb Threat/Search Procedures	$8.00
117	Improvised Lock Picks	$10.00
119	Fitting Keys By Reading Locks	$7.00
120	How to Open Handcuffs Without Keys	$9.95
121	Electronic Locks Volume 1	$8.00
122	With British Snipers, To the Reich	$24.95
125	Browning Hi-Power Pistols	$9.95
126	P-08 Parabellum Luger Auto Pistol	$9.95
127	Walther P-38 Pistol Manual	$9.95
128	Colt .45 Auto Pistol	$9.95
129	Beretta - 9MM M9	$11.95
130	FullAuto Vol 5 M1 Carbine to M2	$9.95
132	Ranger Handbook	$16.95
133	FN-FAL Auto Rifles	$13.95
135	AK-47 Assault Rifle	$11.95
136	UZI Submachine Gun	$9.95
139	USMC Battle Skills Training Manual	$24.95
140	Sten Submachine Gun, The	$9.95
141	Terrorist Explosives Handbook	$6.95
142	U. S. Army Counterterrorism Training Manual	$14.95
143	Sniper Training	$24.95
144	The Butane Lighter Handgrenade	$9.95
146	The Official Makarov Pistol Manual	$12.95
147	Official Makarov 9mm Pistol Manual	$12.95
148	Unarmed Against the Knife	$9.95
149	Black book of Booby Traps	$14.95
151	Militia Battle Manual	$18.95
152	Glock's Handguns	$17.95
153	Heckler and Koch's Handguns	$17.95
154	The Poor Man's R. P. G.	$14.95
155	The Poor Man's Ray Gun	$9.95
156	The Anachist Handbook Vol. 2	$11.95
157	How to Make Disposable Silencers Vol. 2	$16.95
158	Modern Day Ninjutsu	$14.95
159	The Squeaky Wheel	$12.95
160	The Sicilian Blade	$13.95
162	The Anarchist Handbook Vol. 1	$11.95
163	How to Make Disposable Silencers Vol. 1	$16.95
164	The Anarchist Handbook Vol. 3	$11.95
165	How to Build Practical Firearm Silencers	$14.95
200	Fighting Back on the Job	$11.95
202	Secret Codes & Ciphers	$9.95
204	Improvised Munitions Black Book Vol 1	$14.95
205	Improvised Munitions Black Book Vol 2	$14.95
206	CIA Field Exp Preparation of Black Powder	$8.95
207	CIA Field Exp. Meth/Explo. Preparat	$8.95
209	CIA Improvised Sabotage Devices	$12.00
210	CIA Field Exp. Incendiary Manual	$12.00
211	Science of Revolutionary Warfare	$9.95
212	Agents HB of Black Bag Ops.	$9.95
214	Electronic Harassment	$11.95
217	Improvised Rocket Motors	$6.95
218	Impro. Munitions/Ammonium Nitrate	$9.95
219	Improvised Batteries/Det. Devices	$8.95
220	Impro. Explo/Use In Deton. Devices	$7.95
221	Evaluation of Imp Shaped Charges	$8.95
222	American Tools of Intrigue	$12.00
225	Impro. Munitions Black Book Vol 3	$23.95
226	Poor Man's James Bond Vol 2	$24.95
227	Explosives and Propellants	$11.95
229	Select Fire 10/22	$11.95
230	Poor Man's James Bond Vol 1	$24.95
231	Assorted Nasties	$19.95
232	Full Auto Modification Manual	$18.95
234	L.A.W. Rocket System	$8.00
240	Clandestine Ops Man/Central America	$11.95
241	Mercenary Operations Manual	$9.95
250	Improvised Shaped Charges	$8.95
251	Two Component High Exp. Mixtures	$9.95
260	Survival Evasion & Escape	$13.95
262	Infantry Scouting, Patrol, & Sniping	$13.95
263	Engineer Explosives of WWI	$7.95
300	Brown's Alcohol Motor Fuel Cookbook	$13.95
301	How to Build a Junkyard Still	$11.95
303	Alcohol Distillers Handbook	$17.95
306	Brown's Book of Carburetors	$11.95
310	MAC-10 Cookbook	$9.95
350	Cheating At Cards	$12.00
367	Brown's Lawsuit Cookbook	$18.95
400	Hand to Hand Combat	$11.95
401	USMC Hand to Hand Combat	$7.95
402	US Marine Bayonet Training	$8.95
404	Camouflage	$12.95
409	Guide to Germ Warfare	$13.95
410	Emergency War Surgery	$24.95
411	Homeopathic First Aid	$9.95
412	Defensive Shotgun	$12.95
414	Hand to Hand Combat by D'Eliscue	$7.95
415	999 Survived	$6.00
416	Sun, Sand & Survival	$6.00
420	USMC Sniping	$16.95
424	Prisons Bloody Iron	$13.95
425	Napoleon's Maxims of War	$9.95
429	Invisible Weapons/Modern Ninja	$11.95
432	Cold Weather Survival	$11.95
435	Homestead Carpentry	$10.00
436	Construction Secret Hiding Places	$11.95
437	US Army Survival	$29.95
438	Survival Shooting for Women	$11.95
440	Survival Medicine	$11.95
442	Can You Survive	$12.95
443	Canteen Cup Cookery	$9.95
444	Leadership Hanbook of Small Unit Ops	$11.95
445	Vigilante Handbook	$11.95
447	Shootout II	$14.95
448	Catalog of Military Suppliers	$14.95
454	Survival Childbirth	$8.95
455	Police Karate	$10.95
456	Survival Guns	$21.95
457	Water Survival Training	$5.95
470	Emergency Medical Care/Disaster	$11.95
500	Guerilla Warfare	$14.95
504	Ranger Training & Operations	$14.95
507	Spec. Forces Demolitions Trng HB	$16.95
510	Battlefield Analysis/Inf. Weapons	$9.95
511	US Army Bayonet Training	$7.95
512	Desert Storm Weap. Recog. Guide	$9.95
542	Professional Homemade Cher Bomb	$10.95
544	Combat Loads for Sniper Rifles	$12.00
551	Take My Gun, If You Dare	$10.95
552	Aunt Bessie's Wood Stove Cookbook	$7.50
610	Trapping & Destruc. of Exec. Cars	$10.00
C-002	How To Open A Swiss Bank Account	$6.95
C-011	Defending Your Retreat	$9.95
C-020	Methods of Long Term Storage	$8.95
C-023	Federal Firearms Laws	$4.50
C-029	M1 Carbine Arsenal History	$6.95
C-038	Hw To Build A Beer Can Morter	$4.95
C-040	Criminal Use of False ID	$11.95
C-050	Surviving Doomsday	$11.95
C-052	CIA Explosives for Sabotage	$9.00
C-175	Beat the Box	$7.95
C-386	Self-Defense Requires No Apology	$11.95
C-679	M16A1 Rifle Manual Cartoon Version	$6.95
FP-9	Micro Uzi Select Fire Mod Manual	$9.95

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

DESERT Publications

P.O. Box 1751 Dept. BK-154

501-862-2077 **El Dorado, AR 71730-1751 USA** **$5.95 shipping & handling**

The Poor Man's RPG

by George Dmitrieff

George Dmitirieff, noted author of firearms and ammunition publications has expanded into the area of reenactment weapons, specifically the anti-tank grenade and launcher. He provides information and detailed instructions for those interested in building these working devices for fun and show.

Weapons covered are the Bazooka, the Panzerfaust, Rusian RPGs, and the M72-LAW. Propulsion and warhead basics are provided to enable even the novice to understand and recreate working models of these high-performance devices. These weapons can be constructed with readily available materials and tools that are available to anyone.

Desert Publications
A division of Delta Group
P.O. Box 1751
El Dorado, AR 71731-1751 U. S. A.

ISBN 0-876947-154-9
90000
9 780879 471545